DATE REPORT ACCEPTED 8-6-96
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# PRELIMINARY ASSESSMENT
# PIER PROPERTY DRUM
# MANATEE COUNTY, FLORIDA

**FL 0001096718**

**Prepared By:**

**Florida Department of Environmental Protection**
**Division of Waste Management**
**Bureau of Waste Clean-up**
**Technical Review Section**
**Site Screening Superfund Subsection**

March 29, 1996

**Date:** 03/29/96

**Prepared by:**

Craig Feeny

**Site:**

Pier Property Drum
12310 State Road 64
Bradenton, Manatee County, Florida

**EPA ID Number:**

FLD# 0001096718

## 1.0 Introduction

This Preliminary Assessment (PA) report was prepared by The Florida Department of Environmental Protection's Site Screening Superfund Subsection Staff pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986(SARA). The purpose of the PA was to gather and evaluate available file information, to determine the potential for a release of hazardous substances into the environment, and to assess pathways that may be affected by the site. The information presented in the PA was used to determine whether or not a CERCLA site investigation is warranted at the site pursuant to Superfund regulations.

## 2.0 Site Background

### 2.1 Location

The site is a 12-acre property where drummed industrial wastes were buried. The property is located in a mixed rural/commercial/residential area at 12310 State Road 64, near East Bradenton, Manatee County, Florida[1,2]. Surrounding areas are occupied by wetlands on the east and west, SR64 on the north, residential properties to the north and east, and commercial orange groves on the south[1,3]. The approximate latitudinal and longitudinal coordinates of the site are 27°28'47" N and 82°25'14" W, respectively. From Bradenton, the site can be reached by following SR-64 approximately 3 miles east of the I-75 to a dirt road on the south. The site is at the end of the dirt road[1,3,4].

### 2.2 Site Description

The approximate elevation of the site is 30 feet above mean sea level (msl) and on-site topography is generally level. Three buildings (2 sheds/1 barn) are located on the subject property[1,2]. Open fields apparently occupy a large portion of the property. Sixteen formerly-buried drums, containing resins and wastes from the boat works industry, have been reportedly stored above-ground in the southeast corner of the site, near water-filled pits formed as a result of the drum disinterment. Two other possible/suspected drum landfills were identified in the southeastern and central areas of the property. Another on-site area located near SR-64 is littered with debris[1 (p. 1 & Site Map)]. The property is secured with a fence and a locked gate that opens to SR-64[1].

### 2.3 Local Climate

The local climate is subtropical and characterized by long, warm, humid summers and short, mild winters[6,13]. The mean temperature is approximately 72$^{o}$ F with mean January and August temperature of 61.5 and 82$^{o}$ F, respectively[5,6]. Mean annual, net and 2-year/24 hour rainfall for the general vicinity of the site are 56.35, 3.0 and 5.0 inches, respectively[6,7,8].

## 3.0 Site History

### 3.1 Operational History

During 1992-1994, L. Hilton leased the subject property from Ms. J. Pier. During 1993, Mr. Hilton—without the permission of the property owner—evidently buried drums, containing wastes from the boat works industry, on the property[1]. The site was initially recognized by regulatory authorities when the Manatee County Sheriff's Department notified the FDEP of the inappropriate disposal of the drums. Consequently, during 11/94, FDEP located the buried drums in the southeastern portion of the property, dug them out and placed them randomly near the edges of the resultant disinterment pits. Six of the drums were overpacked due to their deteriorated condition[1 (p. 1 & Fig. 2)].

### 3.2 Regulatory/Permitting History

The drums that were buried on-site and without permission of the landowner or the knowledge of regulatory authorities[1]. Accordingly on-site hazardous waste handling was never permitted. Both the Florida Department of Environmental Protection and the United States Environmental Protection Agency have been involved in on-going investigative and remedial action associated with the drum burial[1,2].

### 3.3 Sampling and Analyses

On 1/9/95, the United States Environmental Protection Agency's Emergency Response Team initiated topographical and geophysical surveys of the property and collected samples of ground water, soil, surface water, and drum contents[1,2]. Analyses of the composite liquid drum samples documented traces of pesticides, such as Aldrin (0.18 ug/L), d-BHC (0.6 ug/L), and a-BHC (0.16 ug/L), and high concentrations of aliphatic, aromatic and polycyclic hydrocarbons, including acetone (230,000 mg/L), 2-butanone (89,000 ug/L), benzene (12,000 ug/L), toluene (9,600 ug/L), ethylbenzene (88,000 ug/L), para- & meta-xylene (51,000 ug/L), o-xylene (8,400 ug/L), styrene (16,000,000 ug/L), isopropylbenzene (21,000 ug/L), n-propylbenzene (17,000 ug/L), 1,2,4-trimethyl benzene (45,000 ug/L), and naphthalene (5,000 ug/L). Noteworthy levels of lead (1,200 ug/l), chromium (120 ug/L), and arsenic (22 ug/L) were also detected among drum contents. TCLP analyses of drum solids revealed the following leachable levels of Endosulfan (0.25 ug/L), cadmium (167 ug/L), benzyl alcohol (1,000 ug/L), benzoic acid (270 ug/L), di-n-butylphthalate (40 ug/L), phenol (110 ug/L), and 2-methyl phenol(860 ug/L)[2 (Tables 5-7)]..

Ground water samples collected on-site contained low levels of di-n-butylphthalate (11 ug/L), acetone (8 ug/L), methyl-tert-butyl ether (14 ug/L), toluene (2.2 ug/L), and toxicologically insignificant concentrations of heavy metals[2 (Table 8)]. A surface water sample collected from a water-filled drum disinterment pit contained a low concentration of acetone (7.3 ug/L) and heavy metal concentrations were relatively innocuous[2 (Table 9)].

A sediment sample collected near the northernmost drum disinterment pit contained (in ug/kg) acetone (207), toluene (12), ethylbenzene (670), ortho-xylene (2.4), styrene (2.8), isopropylbenzene (2.1), n-propylbenzene (1.6), 1,2,4-trimethylbenzene (3.3), diethylphthalate (87 J), di-n-butylphthalate (2,765), butylbenzylphthalate (179 J), and bis(2-ethylhexyl)phthalate (338 J)[1 (Table 10 & Fig. 2)]. A TCLP analysis of on-site sediment yielded several waste related hydrocarbons, including benzyl alcohol (16), diethylphthalate (5 J), di-n-butylphthalate (56), and bis(2-ethylhexyl)phthalate (12 J), although the latter 2 compounds were also found in the corresponding blank. No remarkable levels of metals were detected in sediment or its TCLP extract samples[1 (Table 11)].

During 3/96, EPA's Emergency Response Section successfully removed all of the buried drums. Each of the drums was found to be intact and without signs of leakage. Monitoring wells were installed and ground water samples were collected. Subsequent analyses of the samples revealed that ground water was not contaminated[12].

## 4.0 Ground-Water Pathway

### 4.1 Hydrogeologic Setting

The site is located within the Gulf Coastal Lowlands geomorphologic feature of the Central Zone geomorphologic province of Florida[11]. Land surface at the site is relatively flat with an average elevation of 30 feet above mean sea level (msl). Local topography is generally karst [3,5,13(p. 30)].

Underlying stratigraphy is characterized (in descending order) by an uppermost stratum of Pleistocene and Pliocene-age Coastal, shelly, silty sands; an approximately 250-300 foot thick, alternating sequence of phosphate, clay, chert, dense to porous limestones and low permeability dolomite of the Miocene-age, Hawthorn Group[5 (p. 16),10,11,5 (pp. 11,15-18),15]; and an estimated thickness of approximately 1,200-1,400 feet of limestones of the Oligocene-age Suwannee Limestone, Eocene-age Ocala and Avon Park Formations[11, 14 (p.31)].

Three aquifer systems—surficial, intermediate and Floridan—exist within the general vicinity of the site. The surficial aquifer system occupies the Pleistocene and Pliocene sands that occur within the first 25-feet of land surface[13 (Fig. 13)]. The bottom of the system is delimited by a 250-300-foot thick confining layer, composed of low-permeability materials within the Hawthorn Group[13(p. 22),14(pp. 20,24)]. Permeable units within the Hawthorn Group collectively form the intermediate aquifer system. An approximately 1,200-1,400 feet thick interval of subjacent, permeable, Oligocene to Eocene-age limestones, as well as hydraulically contiguous limestones of the Hawthorn Group, represent the Floridan aquifer system[5,10,11,5,13(p. 20),14].

Due its unconfined condition, the surficial aquifer system is directly recharged by local rainfall[5 (p. 21)]. Available data indicate an absence of local recharge to the intermediate and Floridan aquifers[13 (p. 74-78 & Figs. 38, 40-42)].

Ground water within the surficial aquifer generally flows toward the east[2 (p. 10)]. Ground water migration within the intermediate aquifer system is westward[13(pp. 56,60)]. Migration of ground water within the Upper Floridan aquifer system is locally variable, ranging from westward[13(p. 57)] to eastward[13(p. 61)].

The chloride content of local aquifers ranges from 25-250+ ppm in the surficial aquifer system[13(p. 43)], 50-250 ppm in the intermediate and Upper Floridan aquifer systems[13(pp. 54,68)], and >250 ppm in the producing zone of the Lower Floridan aquifer system[13(p. 69)].

### 4.2 Ground-Water Targets

The surficial aquifer system yields only minor quantities of potable ground water, reportedly providing potable water for a limited number of small domestic supplies and non-potable water for irrigation and stock-watering supplies[5 (p. 21)]. The high chloride content of the producing zone of the Lower Floridan aquifer system is unsatisfactory for use in potable supplies[13(p. 69)]. Accordingly, the intermediate and Upper Floridan aquifer systems represent the primary sources of potable ground water for most domestic and public supplies in the general vicinity of the site[5(21-23),13(p. 59-65)].

Very few potable wells have been identified within a 4 mile radius of the site. The nearest well is presumably associated with a residence located approximately 1,000 north of the site[1,3].

**4.3 Ground-Water Conclusions**

Shallow ground water contamination was documented at the site[1,2]. No alternative source of contamination is likely, due to the site's isolated location[3] and the similarity between the contaminants found in the drums and the ground water[1,2]. However, during 3/96, the drums were removed and the adjacent ground water was resampled. Subsequent analyses has revealed no evidence of continuing ground water contamination[12]. Considering that few potable wells exist near the site[3,16], the potential for potable wells to have been, or to be affected by the earlier limited ground water contamination is insubstantial. Accordingly, the Ground Water Migration Pathway represents an inconsequential consideration in the present evaluation.

**5.0 Surface Water Pathway**

**5.1 Hydrology**

Pervasive, isolated, small wetlands exist in the immediate vicinity of the site[1,3] and the site is located within a 100-year flood zone of Gates Creek[18].

**5.2 Surface Water Targets**

No surface water targets merit consideration, given that all sources of contamination have been removed and no evidence of extant ground water contamination remains[12].

**5.3 Surface Water Conclusions**

The Surface Water Migration Pathway is not threatened due to the fact that all sources of contamination have been removed and no evidence of extant ground water contamination remains[12].

## 6.0 Soil Exposure and Air Migration Pathways

### 6.1 Physical Conditions

Contaminated sediment (soil) was documented near areas of unauthorized subsurface disposal of drummed industrial waste. The initially observed levels of contamination are considered less than toxicologically significant[1,2]. All drums have been removed from the site (intact) and concurrent ground water sampling has demonstrated that no evidence of persistent ground water contamination remains[12].

### 6.2 Soil Exposure and Air Migration Targets

Pervasive wetlands have been identified in the general vicinity of the site. However, no residential population is associated with the site[1,2] ] and access to the site is restricted by a perimeter fence with a locked gate[1]. Furthermore, no schools and few residences exist on surrounding properties[1-3]. Given that all sources of contamination were removed (intact)[12], no receptors could reasonably be adversely affected by the site via the Air Migration or Soil Exposure Pathways.

### 6.3 Soil Exposure and Air Pathway Conclusions

On-site sediment (soil) contamination was documented; however, the observed levels of contamination are not particularly hazardous to human health or the on-site wetlands[1,2]. Furthermore, no on-site residents have been identified, site access is restricted, the surrounding off-site properties are sparsely populated[1-3], all sources of contamination were removed, and no evidence of extant contamination remain on-site[12].

## 7.0 Summary and Conclusions

During 1992-1994, L. Hilton leased the subject property from Ms. J. Pier. During 1993, Mr. Hilton—without the permission of the property owner—evidently buried drums, containing wastes from the boat works industry, on the property[1]. The site was initially recognized by regulatory authorities when the Manatee County Sheriff's Department notified of the FDEP of the inappropriate disposal of the drums. Consequently, during 11/94, FDEP located the buried drums in the southeastern portion of the property, dug them out and placed them randomly near the edges of the resultant disinterment pits. Six of the drums were overpacked due to their deteriorated condition[1 (p. 1 & Fig. 2)]. A subsequent investigation by EPA documented shallow ground water contamination[1,2], but since that time all drums have been removed and concurrent ground water sampling and analyses demonstrated no evidence of lingering contamination[12]. Therefore, a **no further action priority** is recommended for further CERCLA action.

# Pier Drum Property
# Preliminary Assessment
# References


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11. Florida Geological Survey, 1991. Florida's Ground Water Quality Monitoring Program Hydrogeological Framework. FGS Special Publication No. 32.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

BUREAU OF WASTE CLEANUP

1

JAN 29 1996

TECHNICAL REVIEW SECTION

ACTION MEMORANDUM — Pier Property Drum Manatee County —

DATE: MAY 19 1995

SUBJECT: Request for a Removal Action at Pier Property Drum Site, Bradenton, Manatee County, Florida

FROM: Charles K. Eger ext - 6134
On-Scene Coordinator

TO: Richard D. Green, Associate Director
Office of Superfund and Emergency Response
Waste Division

Karen Burki ext. 6226

## I. PURPOSE

The purpose of this memorandum is to request and document approval of the proposed removal action described herein for the Pier Property Drum Site (the Site), Bradenton, Manatee County, Florida.

## II. SITE CONDITIONS AND BACKGROUND

### A. Site Description

#### 1. Removal Site Evaluation

Pier Property Drum site is a twelve (12) acre farm located at 12310 State Road 64, Bradenton, Manatee County, Florida. Reportedly, the absentee landowner, Ms. Jean Pier, leased the property to Mr. Lawrence Hilton from 1992 to 1994. In 1993, apparently unbeknownst to Ms. Pier, Mr. Hilton transported and disposed of (through burial) an unknown amount of drums containing resins and wastes associated with the boat works industry. (The burial areas are believed to be in the southern corner of the farm). In November 1994, the Florida Department of Environmental Protection (FDEP) excavated sixteen (16) drums from two (2) pits. The drums remain on-site near the excavation pits. The open pits subsequently filled with water, either from rain or groundwater or a combination of both.

In January 1995, the Environmental Protection Agency's (EPA) Emergency Response and Removal Branch (ERR) requested EPA's Environmental Response Team (ERT) to conduct a geophysical survey to search for buried drums and to collect and analyze soil, groundwater, surface water and drum samples at the Site. Various drums of characteristic hazardous waste, solvents and resins have been positively identified by the previous assessment.

EPA's analytical results of drum samples (from three (3) liquid composites) confirm high levels volatile organic compounds (VOCs), especially acetone and styrene. In addition, two (2) Base Neutral Acids (BNAs) (benzyl alcohol and benzoic acid) and two (2) metals (sodium and calcium) were detected (see tables 1 and 2).

Elevated concentrations of metals and VOCs were detected in groundwater samples. However, no concentrations were detected above the Maximum Concentration Limits (MCL) for those analytes with an established MCL.

Phthalates were the only BNAs detected in the soil samples. Metals and low levels of VOCs were also detected.

2. Physical location

The Site is situated in a rural setting located in eastern Bradenton, Florida, east of Interstate 75 at Exit 42 at 12310 State Road 64 (SR 64). The surrounding area is mixed, encompassing both commercial and residential aspects. Commercial orange groves are located to the south of the Site, wetlands are located to the east; and residential properties to the north and east.

3. Site Characteristics

The Site is approximately twelve (12) acres in area, with SR 64 bordering 335 feet along the northern edge of the property. It runs nearly 1000 feet in a north-south direction. Most of the Site is open field or pasture. One barn and several sheds occupy the southwestern side of this parcel. As stated previously, the drum burial area is located in the southeastern corner of the Site. The property is fenced and locked to prevent ready access (see figure 1).

4. Released or threatened release into the environment of a hazardous substance or pollutant or contaminant

Any metal drums exposed to the environment in this area are subject to accelerated deterioration due to the weather. Waste released from the drums will increase the surface area available for direct exposure to contaminants and potentially increase off-site migration. Elevated VOCs (acetone and styrene) and BNAs are present in drums.

Groundwater is situated at approximately 1.5 feet to 2 feet below ground surface (bls). An unknown number of drums remain in contact with the groundwater regime. Elevated levels of metals and VOCs have been previously detected in groundwater samples. This confirms the release of contaminants and/or pollutants to the environment.

TABLE I
SUMMARY OF RESULTS FOR DRUM LIQUID COMPOSITE SAMPLES
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

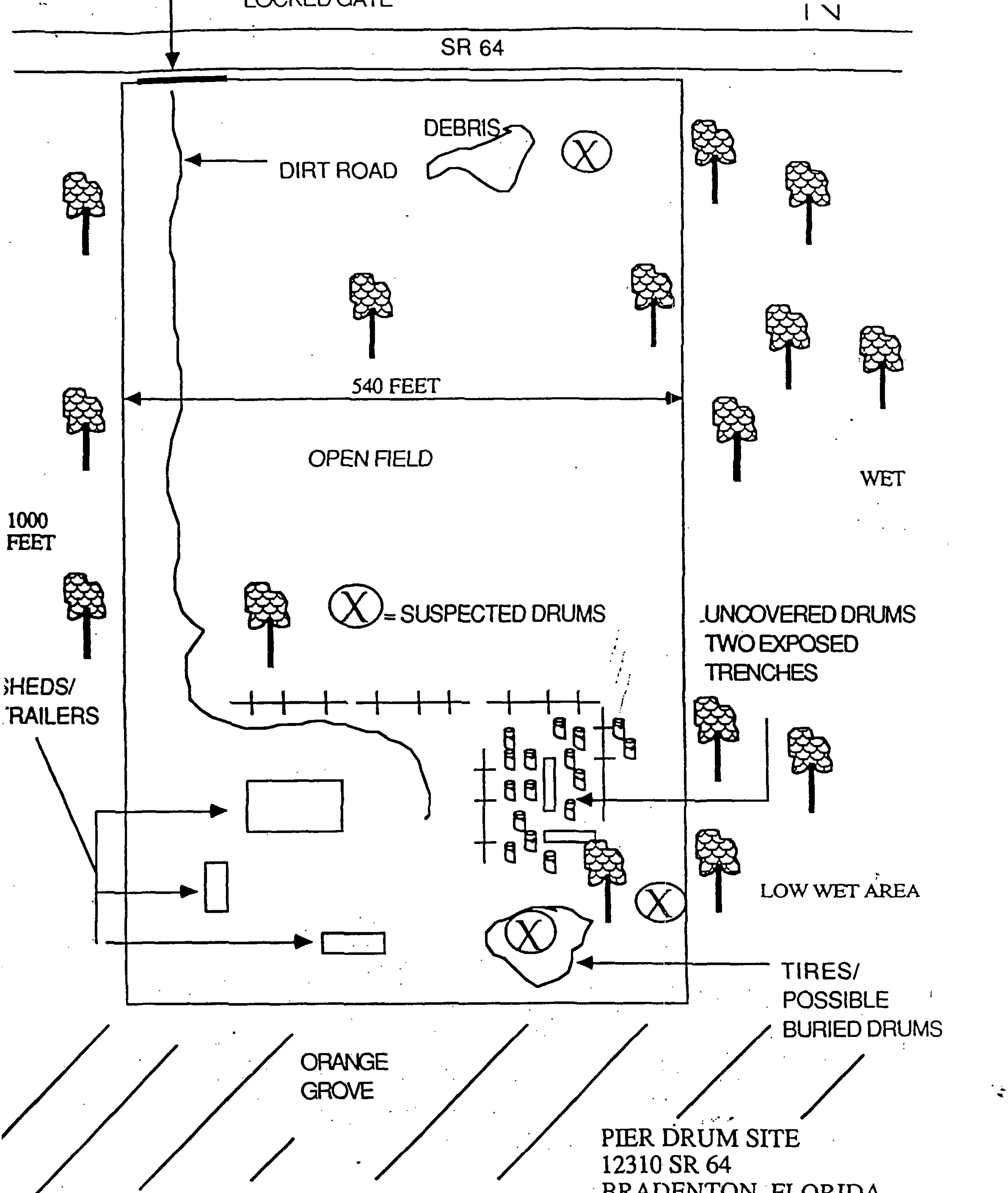
| SAMPLE ID | 00912 | | 00913 | | 00914 | |
|---|---|---|---|---|---|---|
| SAMPLE LOCATION | REAC#9 | | REAC#2 | | REAC#4 | |
| PARAMETER | Conc µg/L | MDL µg/L | Conc µg/L | MDL µg/L | Conc µg/L | MDL µg/L |
| *METALS* | | | | | | |
| Aluminum | 690 | 100 | ND | 100 | 25000 | 100 |
| Arsenic | ND | 10 | ND | 10 | 22 | 10 |
| Barium | 29 | 10 | 23 | 10 | 240 | 10 |
| Cadmium | 7.0 | 4.0 | 34 | 4.0 | ND | 4.0 |
| Calcium | 410* | 0.20* | 400* | 0.20* | 37* | 0.20* |
| Chromium | 80 | 10 | 120 | 10 | 47 | 10 |
| Cobalt | 7300 | 10 | 40000 | 10 | 900 | 10 |
| Copper | 520 | 10 | 150 | 10 | 660 | 10 |
| Iron | 18* | 0.05* | 360* | 0.05* | 310* | 0.05* |
| Lead | 61 | 10 | 1200 | 10 | 38 | 10 |
| Magnesium | 8000 | 1000 | 8000 | 1000 | 10000 | 1000 |
| Manganese | 3000 | 4.0 | 5700 | 4.0 | 1500 | 4.0 |
| Nickel | 66 | 20 | 850 | 20 | 30 | 20 |
| Potassium | 12000 | 4000 | 35000 | 4000 | 12000 | 4000 |
| Sodium | 21000 | 1000 | 71000 | 1000 | 29000 | 1000 |
| Vanadium | ND | 10 | ND | 10 | 32 | 10 |
| Zinc | 1900 | 10 | 3600 | 10 | 330 | 10 |
| *PEST/PCB's* | | | | | | |
| a-BHC | 0.16 | 0.11 | ND | 0.11 | ND | 0.11 |
| Aldrin | ND | 0.11 | 0.18 | 0.11 | ND | 0.11 |
| *VOC's* | | | | | | |
| Acetone | 130000* | 10* | 230000* | 10* | 14000* | 20* |
| 2-Butanone | ND | 20000 | ND | 20000 | 89000 | 4000 |
| Benzene | 11000 | 5000 | 12000 | 5000 | ND | 1000 |
| Toluene | 5400 | 5000 | 4100J | 5000 | 9600 | 1000 |
| Ethylbenzene | 21000 | 5000 | 88000 | 5000 | 37000 | 1000 |
| p&m Xylene | 16000 | 5000 | 51000 | 5000 | ND | 1000 |
| o-Xylene | 8400 | 5000 | ND | 5000 | 800J | 1000 |
| Styrene | 1200000 | 5000 | 16000000 | 5000 | 26000 | 1000 |
| Isopropylbenzene | 6500 | 5000 | 21000 | 5000 | ND | 1000 |
| n-Propylbenzene | 7600 | 5000 | 17000 | 5000 | ND | 1000 |
| 1,2,4-Trimethylbenzene | 17000 | 5000 | 23000 | 5000 | 45000 | 1000 |
| Naphthalene | 3400J | 5000 | ND | 5000 | 7200 | 1000 |

MDL = Method Detection Limit
ND = Not Detected
* = Concentration and MDL reported in milligram per liter (mg/L)
NOTE: Mercury analysis was not performed due to insufficient sample size.

TABLE 2
SUMMARY OF TCLP ANALYSES RESULTS FOR DRUM SOLIDS
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

| PLE NUMBER | 00911 | | 00915 | | 00916 | |
|---|---|---|---|---|---|---|
| PLE LOCATION | REAC# 1,8,9,11 | | REAC#5 | | REAC#3,7,10,13,14 | |
| AMETER | CONC µg/L | MDL µg/L | CONC µg/L | MDL µg/L | CONC µg/L | MDL µg/L |
| 's | | | | | | |
| :yl Alchohol | 1000 | 20 | 83 | 20 | 150 | 20 |
| :oic Acid | 120 | 20 | 270 | 20 | 4800E | 20 |
| 1–butyl phthalate | 40 | 20 | 34 | 20 | 9J | 20 |
| 1ol | 110 | 20 | 17J | 20 | 34 | 20 |
| 1ethylphenol | 860 | 20 | ND | 20 | ND | 20 |
| TALS | | | | | | |
| mium | 167 | 80 | ND | 4 | ND | 4 |
| :ium | 435000 | 2500 | 2800 | 250 | 1290 | 250 |
| 3alt | 470 | 250 | ND | 250 | ND | 250 |
| 3per | ND | 50 | ND | 50 | 50 | 50 |
| 1 | 2190 | 200 | ND | 200 | 760 | 200 |
| d | 102 | 20 | 7.9 | 5 | 6.1 | 5 |
| gnesium | 4300 | 500 | 300 | 50 | 170 | 50 |
| nganese | 350 | 100 | ND | 100 | ND | 100 |
| :assium | 4200 | 1000 | 1580 | 100 | 570 | 100 |
| dium | 3100000 | 500000 | 2300000 | 500000 | 1800000 | 500000 |
| :c | 440 | 50 | 210 | 50 | 130 | 50 |
| :ST/PCB's | | | | | | |
| IC–delta | 0.6 | 0.18 | ND | 0.11 | ND | 0.25 |
| dosulfan–alpha | ND | 0.18 | ND | 0.11 | 1.0 | 0.25 |
| OC's | | | | | | |
| :etone | 1300000D | 5000 | 11000J | 5000 | ND | 2500 |
| yrene | 6100 | 5000 | 130000 | 2000 | 40000 | 2500 |

)L = Method Detection Limit
) = Not Detected
= Exceeds calibration range, estimated value
= Detected Below Detection Limit




PIER DRUM SITE
12310 SR 64
BRADENTON, FLORIDA

5. NPL status

This Site is not on the NPL nor is it expected to attain a Hazardous Ranking Score sufficient to make the NPL.

B. Other Action to Date

1. Previous actions

EPA Region 4 and EPA ERT personnel conducted a Site assessment between January 9 - 13, 1995. In addition, geophysical monitoring and topographical surveying were conducted.

2. Current actions

Currently, there are no governmental or private cleanup efforts occurring at the Site.

C. State and Local Authorities' Role

1. State and local actions to date

After being notified of the Site by the Manatee County Sheriff's Office, FDEP inspected the Site and uncovered sixteen (16) buried drums. Samples taken confirmed the presence of ketone and other organics. Groundwater samples detected acetone, which is thought to be representative of resins and wastes associated with boat works (per FDEP). Six drums were over-packed because of their deteriorated condition.

**III. THREATS TO PUBLIC HEALTH OR WEALTH OR THE ENVIRONMENT AND STATUTORY AND REGULATORY AUTHORITIES**

A. Threats to Public Health or Welfare

The Emergency Response and Removal Branch has determined that a release threat, defined by Section 101 of CERCLA, exists at the Pier Property Drum Site. The Site meets the requirements for initiating an immediate removal according to the criteria listed in Section 300.415(b)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In evaluating the potential risks posed by the compounds listed in Section II(a)(4) of this Action Memorandum, the following factors cited from the NCP must be considered in determining the appropriateness of a removal action:

> Section 300.415(b)(2)(iii): "Hazardous substances or pollutants or contaminants in drums, barrels, tanks or other bulk storage containers, that may pose a threat of release."

At least sixteen drums are suspected to contain hazardous waste material or a hazardous waste residue. Site investigations and sample analysis identified drum contents which confirm elevated levels of acetone, benzene, ethylbenzene, xylene and styrene.

> Section 300.415 (b)(2)(iv): "High levels of hazardous substances or pollutants or contaminants in soils largely at the surface, that may migrate."

Soil contamination is prevalent throughout the area where the buried drums were uncovered. Elevated levels of metals and extractable acids have been identified in the soil.

> Section 300.415 (b)(2)(vii): "Availability of appropriate federal or state response mechanisms to respond to the release".

Potentially Responsible Parties (PRPs) have been identified for this site. It is not expected that the PRPs will respond and perform a removal in a timely manner. It is not expected that the State or any other governmental entity will conduct the necessary remediation activity.

## IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of the hazardous substances from this site, if not addressed by implementing the removal action selected in this Action memorandum, may be an imminent and substantial endangerment to the public health or welfare or the environment.

## V. PROPOSED ACTIONS AND ESTIMATED COSTS

### A. Proposed Actions

#### 1. Proposed action description

The only feasible solution for mitigating threats posed by this site is the removal of the waste solvents, buried drums, and contaminated soil. Activities involve the uncovering of any remaining buried drums at the site, sampling of drums contents, bulking of liquid and sludge waste for shipping, treatment and/or disposal of materials off-site. Contaminated soils will be excavated, sampled and disposed of at a RCRA approved facility.

#### 2. Contribution to remedial performance

Based on the information available, the proposed removal action will abate the immediate threats identified in Section III of this Action Memorandum. The proposed action will remove the primary sources of groundwater contamination and will be consistent with any long term clean-up goals.

3. Description of alternative technologies

Because the disposition of the waste materials at the Site has not been determined, no formal evaluation of alternative technologies has been made. Such an evaluation will take place before the disposal phase of the response action and will be documented at the time.

4. Applicable or relevant and appropriate requirements (ARARs)

Federal ARARs presently determined to be applicable to the activity at this site are the Resource Conservation Recovery Act (RCRA), land disposal regulations (LDRs), and the Department of Transportation (DOT) requirements for hazardous waste transport.

Presently FDEP has identified no additional ARARs.

5. Proposed schedule

Response actions at this site will be initiated upon approval of this Action Memorandum. Foregoing any unexpected delays, all actions are expected to be completed within one (1) year of mobilization on-site.

B. <u>Estimated Costs</u>

Extramural Costs

| | |
|---|---|
| Regional Allowance Cost | |
| ERCS | $ 100,000 |
| Non Regional Allowance Cost | |
| TAT | $ 20,000 |
| Subtotal | $ 120,000 |
| 20% Contingency | $ 24,000 |
| Total, Extramural Cost | $ 144,000 |

Intramural Cost

| | |
|---|---|
| Direct (100 hours at $30.00/hour) | $ 3,000 |
| Indirect (100 hours at $54.00/hour) | $ 5,400 |
| Total, Intramural | $ 8,400 |
| TOTAL SITE BUDGET | $ 152,400 |

## VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR TAKEN

If this action is significantly delayed or is not initiated, there will continue to be a release of hazardous substances into the environment. This will likely increase the potential for exposure to the public and/or the environment.

## VII. OUTSTANDING POLICY ISSUES

None.

## VIII. ENFORCEMENT

Presently, there are no identifiable Peps that may undertake response actions. If additional information becomes available during the removal action, appropriate enforcement action will be taken and documented.

## IX. RECOMMENDATION

This decision document represents the selected removal action for the Pier Property Drum Site in Bradenton, Manatee County, Florida; developed in accordance with CERCLA as amended and consistent with the National Contingency Plan (NCP). The document is based on the administrative record for the Site.

Conditions at the Site meet the NCP section 300.415(b)(2) criteria for a removal and I recommend your approval of the proposed removal action. The total project ceiling will be $ 152,400.

Approval James S Kutzman Date 5/17/95

Disapproval ______________________________ Date ____________

Roy F. Weston, Inc.
GSA Raritan Depot
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2

BUREAU OF WASTE CLEANUP

JAN 29 1996

TECHNICAL REVIEW SECTION

DATE: March 24, 1995

TO: Greg Powell, U.S. EPA/ERT Work Assignment Manager

THROUGH: John N. Dougherty, REAC Geosciences Group Leader RMS for J. Dougherty

FROM: Ray Lewis, REAC Task Leader S.T for R.L

SUBJECT: PIER DRUM, BRADENTON, FL
WORK ASSIGNMENT 0-098-TRIP REPORT

## 1.0 INTRODUCTION AND BACKGROUND

The U.S. Environmental Protection Agency (U.S.EPA) Region IV requested that the U.S. EPA/Environmental Response Team (ERT) conduct a geophysical survey to search for buried drums and collect and analyze soil, groundwater, surface water, and drum samples at the Pier Drum site in Bradenton, FL. The ERT activated the Response Engineering and Analytical Contract (REAC) on December 30, 1994, under Work Assignment 0-098, to provide personnel and equipment for a geophysical survey and drum, water, and soil sampling and analysis. Sam Getty, Michael Morganti, and Ray Lewis completed the sampling effort, and Stewart Sandberg and Jyotiranjan Kar performed the geophysical survey.

### 1.1 Site Description

The Pier Drum site is located in Bradenton Township, Manatee County, FL. The site is approximately 12 acres in size and is in a rural setting. Most of the property is open field, with a barn and sheds along the south side (Figure 1). In November 1994, the Florida Department of Environmental Protection (DEP) excavated 16 drums from two pits in the southeast corner of the site (Figure 2). The drums remain on-site near the excavation pits. The open pits subsequently filled with water, either from rain or groundwater or a combination of both.

### 1.2 Observations and Activities

Groundwater, surface water, sediment, and drum samples were collected during this sampling effort. In addition, geophysical monitoring and topographical surveying were conducted. Field work began on Monday, January 9, 1995 and concluded on Friday, January 13, 1995.

# 2.0 METHODOLOGY

## 2.1 Sampling Activities

For all of the sampling activities, sample documentation was completed in accordance with ERT/REAC SOP # 2002, Sample Documentation, and ERT/REAC SOP # 4010, Chain of Custody (COC). The packaging and shipment of samples was completed in accordance with ERT/REAC SOP # 2004, Sample Packaging and Shipment. Field data sheets and COCs are provided in Appendix A.

### 2.1.1 Drum Sampling

Drums were sampled after they were opened with non-sparking beryllium tools. Samples were collected utilizing glass drum thieves and deposited into 32-oz glass jars for field screening. Drum samples were collected in accordance with ERT/REAC SOP # 2009, Drum Sampling. Drum samples were referenced according to the REAC's numbering system (REAC#1 through REAC#16) and the sample numbers correspond to Florida DEP numbers. Drums REAC#6, REAC#15, and REAC#16 could not be opened because they were filled to the top and the contents had solidified; therefore, they were not sampled. Drum REAC#12 was not sampled upon the instruction of the work assignment manager because it has the same contents as drum REAC#10.

### 2.1.2 Chemical Categorization Screening

Upon completion of the initial sampling, drum samples were chemically categorized using the Sensidyne Haztech™ Hazcat Kit (Hazcat) quick test methods. Quick test methods include the following individual tests: water reactivity/solubility, hairpin explosivity, oxidizer, acid/base pH, cyanide, chlorine hot wire, and organic peroxide. Samples which showed a positive response to the chlorine hot wire test were also screened with Chemetrics™ Quantichlor Chlorine in Waste Oil and Dexsil™ Chlor-in oil PCB test kits.

Each sample was tested for ignitability prior to the chemical testing with an Erdco™ Setaflash Flash Point Tester (Setaflash). The Setaflash was set at 140 degrees Fahrenheit (°F) in order to characterize the sample as ignitable under Resource Conservation and Recovery Act (RCRA) regulations.

Samples were also characterized using a Spil-fyter™ Chemical test strip. Spil-fyter Chemical test strip consists of five colorimetric tests: an acid/base risk test; an oxidizer risk test; a fluoride risk test; an organic solvent/petroleum distillate risk test; and an iodine, bromine, and chloride risk test.

Upon completion of chemical categorization screening, six composite samples were sent out for further laboratory analyses. Composite samples 00911, 00915, and 00916 were sent for TCLP VOA, TCLP BNA, TCLP PCB/Pesticides, and TCLP Metals analyses. Samples 00912, 00913, and 00914 were split and sent to two different laboratories for TCL VOC, BNA, and PEST/PCB, TAL metals, percent moisture, percent sulfur, percent chlorine, British Thermal Units (BTU), and ash content analyses.

The following is a description of the field tests that were used to characterize the samples.

Water Reactive/Solubility Test:

A small amount of sample was added to 1/2 inch of water in a test tube. If the sample did not effervesce, a stopper was placed in the test tube. The test tube was then shaken vigorously. After allowing time for a reaction to occur, the results were recorded. This test determined whether a sample is water reactive or soluble in water.

Oxidizer Test:

Two or three drops of acid test solution were placed on the oxidizer test paper and the sample was touched with the paper. An oxidizer turns the paper blue to black. If the test was positive, the pH of the sample was tested. If the pH was less than or equal to 2, the sample was classified as an oxidizer and no other tests needed to be performed. If the pH was greater than 2, the sample was tested for ignitability.

If the sample was ignitable, then it was classified as an organic peroxide. If it failed the ignitability test, the sample was classified as an oxidizer.

If the oxidizer test proved negative, the pH of the sample was tested. Samples with a pH greater than or equal to 12 were tested for $CN^-$. If the pH was between 2.5 and 12, the sample was tested for ignitability. For a pH less than 2.5, the sample was classified as an acid and the test ended.

Ignitability Tests:

The following tests were performed to determine the ignitability of the sample:

- Hairpin Test:

  The hairpin test is a test for explosiveness. A grain-size solid or a drop of liquid sample was placed on a watch glass. A hairpin was heated until red hot, and then touched to the sample. If the sample ignited into flames, the sample was classified as an explosive.

  If there was no reaction from the hairpin test, a lit match was used to ignite the liquid in a watch glass.

| | | |
|---|---|---|
| Observations: | Extremely Flammable: | Flame jumps from match to liquid. |
| | Flammable: | Stays ignited after removing match. |
| | Combustible: | Requires match as a wick. |
| | Non-Flammable: | Will not ignite. |

• Setaflash Test:

The Setaflash tester was set at 140 °F in order to characterize the liquid as ignitable under RCRA regulations. A small amount of each sample was placed into the chamber of the instrument and heated to 140°F. Once the sample amount reached 140°F, a flame was introduced to the headspace of the chamber. If a flash occurred, the sample was characterized as ignitable. The results were recorded in the log book as "flash" or "no-flash," with flash indicating that the sample was ignitable.

• Cyanide Test:

A small amount of $CN^-$ test 2 solution was added to a test tube containing 1/4 inch of $CN^-$ test 1 solution. Approximately 1/2 inch of the sample was added to another test tube. The $CN^-$ test solution was added to the sample solution and then an acid test solution was added. A deep prussian blue color indicated the sample contained cyanide. A positive result for $CN^-$ ended the test and the sample was classified as a $CN^-$. A negative result for $CN^-$ ended the test and then the sample was classified as caustic.

• Chlorine Hot Wire Test:

A chlorine hot wire was heated in a torch flame until there was no green flame. The wire was then allowed to cool. The wire was placed into a test tube containing the sample and reheated in a torch flame. A green flame indicated the sample contained chlorine, amine, nitrate, or ammonium salt.

• Organic Halogenated Solvent Test:

Based on the results of the combustibility test, the Setaflash test, the chlorine hot wire test and the water reactive/solubility test, an assumption was made as to whether or not the sample was an organic halogenated solvent.

Clor-N-Oil test:

The Clor-N-Oil test was used to check samples for PCBs. A precise amount of sample was placed into a tube. A colorless ampule containing a catalyst was broken and thoroughly mixed with the sample. A second ampule containing metallic sodium was broken and the sodium, activated by the catalyst, stripped chlorine from the sample forming sodium chloride. A buffer solution in water was added to the sample which neutralized the excess sodium and extracted the sodium chloride into the water. The water layer was then separated from the sample.

An ampule containing a precise amount of reagent was broken and mixed with the water. An indicator ampule was then broken and mixed. The color of the mixture depended on the amount of PCBs (chlorine) in the sample.

The Clor-N-Oil test kit works on the principle of chloride determination. Since PCBs contain chlorine, the test kit is able to detect them. However, the test cannot distinguish between any other chlorine containing compound such as trichlorobenzene which may also be in transformer oil. This may cause a result which is known as a "false positive"; i.e., the oil may indicate the presence of over 50 ppm PCBs, but when analyzed by a gas chromatography, it will show somewhat less than 50 ppm.

Quanti-Chlor ®[1]

In addition to and in support of a positive result with a Clor-N-Oil test, a Quanti-Chlor® test kit was used. The Quanti-Chlor test yields quantitative results in micrograms per gram (µg/g) total chlorine in waste oil. Organic chlorine is converted to chloride with naphthalene, dig-lyme, and metallic sodium. The chloride was extracted into an aqueous buffer and titrated with mercuric nitrate. Diphenylcarbazone was the endpoint indicator. Titrets®[2], hand-held titration cells, were used in the mercuric nitrate titration.

Spil-fyter Chemical Classifier Test Strip:

In addition to the field screening tests, a Spil-fyter chemical classifier test strip was used on each sample. The results of the Spil-fyter strips were used as a secondary test to help support the data from the HAZCAT tests. Some interferences that the Spil-fyters have are concentrated acid solutions that tend to destroy the indicators, heavy oils and opaque solutions mask the colors, and light weight organic solvents cause color bleeding. The detection limits of the Spil-fyter are:

- 1 milligram/liter ($^{mg}/_{L}$), Chlorine,
- 3 $^{mg}/_{L}$, Hydrogen Peroxide,
- 20 $^{mg}/_{L}$, Fluoride and
- 10 $^{mg}/_{L}$, Gasoline.

2.1.3 Groundwater Sampling

Four temporary monitor wells were installed using hand augers (Figure 1). The PVC screens were installed approximately 2-3 ft below the water table. Prior to sampling, each monitor well was developed by purging until clear water (< 50 Nephelometric Turbidity Units) was produced. Well development was performed in accordance with U.S. EPA/ERT/REAC SOP # 2044, Well Development. Peristaltic pumps were used to develop and sample the wells. Between 20 and 25 gallons of water were purged from each well during development. Periodically during development, pH, dissolved oxygen, temperature, and conductivity were monitored using the Omega Water Analyzer™. Turbidity was monitored using the Lamont Turbidity Meter™. The instruments were calibrated daily to ensure accurate measurements. Temperature, pH, dissolved oxygen, conductivity, and turbidity, were measured in each well (Table 1).

Depth to water measurements were taken after development of each well. Water level measurements were recorded in accordance with ERT/REAC SOP # 2043, Water Level Measurement. These measurements were used to determine groundwater elevation (Table 2) and flow direction.

[1] Quanti-Chlor ® is a registered trademark of CHEMetrics, Inc.

[2] Titrets ® is a registered trademark of CHEMetrics, Inc.

Groundwater samples were collected in accordance with ERT/REAC SOP # 2007, Groundwater Well Sampling. The groundwater samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), base, neutral, and acid extractable compounds (BNAs), pesticides/polychlorinated biphenyls (PEST/PCBs), and Target Analyte List (TAL) metals. Both filtered and unfiltered samples were analyzed for TAL metals.

2.1.4 Surface Water Sampling

Two surface water samples were collected from the excavation pits in accordance with ERT/REAC SOP # 2013, Surface Water Sampling. The surface water samples were analyzed for TCL VOAs, BNAs, PEST/PCBs, and TAL metals.

2.1.5 Sediment Sampling

Three sediment samples were collected from the excavation pits using hand augers. The sediment samples were collected in accordance with ERT/REAC SOP # 2016, Sediment Sampling. These samples were analyzed for TCL VOCs, BNAs, PEST/PCBs and TAL metals. In addition, these samples were analyzed for Toxic Characteristic Leaching Procedure (TCLP) for the same parameters.

2.1.6 Geophysical Survey

A survey was performed to detect and delineate geophysically anomalous areas indicative of buried drums within a 12-acre portion of the site. Variations of the earth's local magnetic field intensity occur in the vicinity of ferromagnetic objects. It is common practice to measure this field, alone or in combination with its vertical gradient, to locate buried ferromagnetic objects (such as steel drums). Empirical studies have shown that an individual 55-gallon steel drum can be detected when buried in relatively nonmagnetic material to depths of up to 10 feet.

Electromagnetic instruments can be used to detect anomalous conductivity enhancements such as those due to buried metallic objects (such as steel drums). Scattering of the quadrature-phase component of the induced electromagnetic field is used to determine the bulk electrical conductivity, or terrain conductivity, of the shallow subsurface. Enhancements of the inphase component of the scattered electromagnetic field result from the presence of relatively good conductors, such as buried metallic objects.

Geophysical methods used in this investigation included electromagnetics and magnetics. A GEM® Systems model GSM-19 magnetometer/gradiometer was used to obtain the earth's total magnetic field intensity and vertical magnetic field gradient at geophysical grid stations. In addition, a Geonics® EM-31 terrain conductivity instrument was used to obtain terrain conductivity and inphase readings at these same locations. A brief description of these methods follows.

A geophysical grid was established using a compass and a measuring tape, consisting of traverses spaced 20 feet apart, upon which stations were located at 5-foot intervals. The geophysical grid is shown on data plots in which station locations are posted with a "+" symbol (Figure 3). Line orientations were magnetic north-south, and wooden stakes were used to indicate the locations of the 0 North grid position on each line.

Data obtained each day were downloaded into a portable computer where profiles were viewed for preliminary data inspection and interpretation. Hard copy plots of specific traverses were produced to aid in interpretation. A preliminary interpretation was available the following morning.

Electromagnetics (EM-31): The electromagnetic method (EM) is a geophysical technique based on the physical principle of inducing and detecting electrical current flow within the earth, including any conductors contained (buried) therein. The EM-31 is a fixed-coil (approximately 10-foot separation) electromagnetic instrument that generates an electromagnetic field at a known frequency. The primary coil transmits the electromagnetic field and the receiving coil measures the change in electric and magnetic components (secondary electromagnetic field) of the field after propagation through the earth. The EM-31 measures two quantities: the inphase and quadrature phase components of the secondary electromagnetic field. The inphase measurement is more sensitive to good conductors (metallic objects) than the quadrature phase component. The quadrature phase measurement is commonly used to measure directly the bulk conductivity (or its inverse, resistivity) of lithologic materials. For this reason, the inphase component was closely reviewed for anomalies indicative of buried drums. Also, the quadrature phase component was useful for delineating changes in the conductivity due to excavation and subsequent burial.

Prior to use of the EM-31, the instrument was calibrated according to the manufacturer's recommendations. A data logger was used to record both inphase and quadrature phase measurements as well as all pertinent site features (e.g., metallic debris, power lines, buildings, etc.) to ensure quality data and assist in anomaly delineation.

The EM data was obtained at 5-foot intervals along traverses spaced 10 to 40 feet apart, depending upon specific site characteristics. A series of these traverses formed a data collection grid. The end points of each traverse were marked for subsequent anomaly location using stakes, flagging, or spray paint.

Anomalous responses resulting from metallic objects located on the surface were plotted in profile and contour form. Profile plots were used for interpretation on a per line basis, and contour plots were used to visualize spacial variations in instrument response over a large area.

Magnetics: The objective of the magnetic survey was to map magnetic field anomalies and thereby locate their ferromagnetic sources, in this case steel drums. The lines and sample nodes were spaced in the identical locations as those of the EM transects. Both magnetic and magnetic gradient data were electronically recorded.

The magnetic method involves precisely measuring the earth's magnetic field. A magnetometer is used to measure variations in this field over an area of interest. Local variations, or anomalies, in the earth's magnetic field are caused most often by nearby concentrations of ferromagnetic material. In this specific instance, a metallic cylinder, cement pad, steel fences and gates, as well as other surficial metallic debris, were the cause of the detected anomalies. The magnetometer used was the GEM® Systems, GSM-19B Overhauser Effect Gradiometer.

A magnetic base station was established in an area of low magnetic gradient (approximately $\pm$ 5 nanoTesla/meter) and measurements were periodically taken at this location during the magnetic survey to monitor the diurnal variation of the earth's magnetic field. As above, all pertinent site features (e.g., metallic debris, metal trailer, metal tank, steel gate, cement pad, steel fence, etc.) were recorded in a field notebook to ensure quality data and assist in anomaly delineation. All magnetic and gradient data were electronically recorded in the GSM-19B control console/data logger.

Total field magnetic data normally include the effects of diurnal variations of the earth's magnetic field. The diurnal variations were closely monitored by repeated observation of the total magnetic field every half hour.

#### 2.1.7 Topographical Surveying

A topographic survey was conducted using a Topcon™ electronic total station. The total station uses infrared light to calculate distances and angles between points. The survey was used to determine the relative locations and elevations of the geophysical grid, sampling locations, and other site features such as buildings, fences, and roads. This data was used to produce the geophysical data and the maps included in this report and, when combined with the water level measurements from the wells, to determine the direction of groundwater flow.

## 3.0 RESULTS

### 3.1 Sampling Activities

#### 3.1.1 Chemical Categorization Screening

Drum contents were categorized using several field screening methods (Table 3). Based on the results of the screening, samples were composited into three solid samples and three liquid samples. The solid samples were analyzed for TCL/TAL and TCLP analytes. The liquid composites were analyzed for disposal characteristics and TCL analytes (Table 4).

Appendix A contains the field notes and Appendix B contains the results of additional field screening methods.

#### 3.1.2 Drum Samples

The results of the analysis of the three liquid composites indicate high levels of VOCs, especially acetone and styrene (Table 5). No BNAs were detected in any of these liquid samples. All three drum samples contained elevated levels of sodium, potassium, manganese, magnesium, and cobalt. The results of the disposal characterization analyses indicate that samples REAC #2 and REAC #9 have high BTU levels and low percent moisture where as sample REAC #4 has a low BTU and high percent moisture (Table 6). Percent ash, chloride, and sulfur were relatively low and consistent in all three samples. REAC #2 and REAC #4 were overpacked due to poor condition.

The results of the TCLP analysis for
concentrations of VOCs are present.
benzoic acid) and two metals (sodium a
levels of PEST/PCBs were very low leve

3.1.3 Groundwater Samples

Elevated concentrations of metals and
However, no concentrations were detec
(MCL) for those analytes with an esta
and Florida state MCLs. There was v
of the filtered and unfiltered sample
majority of the metals in the groun
detected in groundwater samples (Ta

3.1.4 Surface Water Sampling

PEST/PCBs were not detected in a
(di-n-butylphthalate) and one VO
metals analyses results indicate tha
samples are dissolved in the water
filtered and unfiltered sample c
calcium, and aluminum were detec
were detected above MCLs.

3.1.5 Sediment Samples

Phthalates were the only BNAs
compounds were also detected
also detected in sediments (Tab

The results of the TCLP analy
detected. Of the BNAs detected
ethylhexyl)phthalate were also
in low concentrations. No PE
(Table 11).

3.2 Geophysical Survey

3.2.1 Geophysical Results

Contour plots of magnetic
EM-31 terrain conductivity
that some contours and co
are located, and are there
drawn greater than 20-fee
interpolations.

Electromagnetic site fea
a metal tank, debris pil
drums are evident in the
type anomalies can be a
observed within a shall
all of the excavated dr

A metal automobile gas tank was noted on Line 100W, Station 125N and is apparent in the data as the peak in the EM-31 inphase (see Appendix C). The peak in the EM-31 inphase data, as shown in EM Line 60E, Station 150N (Appendix C) corresponds to the interpreted cache of drums. The magnetic gradient field corresponding to Line 60E, Station 150N indicates a low peak anomaly. The pattern depicting the surface debris pile on line 60E, Station 50N (Appendix C) indicates a high peak for the EM-31 inphase component and a low trough for the magnetic gradient component.

The diurnal variations may be neglected after careful observations of the total magnetic field at the base station and comparison with a strong anomaly of about 47500nT due to drums exposed in the pit on Line 60E, Station 150N (Figure 5). Therefore, the diurnal variation amplitude is relatively insignificant, indicating that diurnal corrections to these data are not necessary for the purposes of identifying large metallic responses.

### 3.3 Groundwater Elevation and Flow

The depth to water measurements were recorded after the development of each well. Based on the elevations of the groundwater, the flow direction was determined (Figure 8). Groundwater flow appears to be flowing in an easterly direction.

## 4.0 Conclusions

Sixteen drums were sampled to determine disposal characteristics. Based on the results of the field tests, the drum samples were composited into three liquid and three solid samples. Results of the analyses indicate elevated levels of volatile organics and metals.

Surface water, groundwater, and sediment samples were also collected. No analyte exceeded established MCLs for the groundwater and surface water samples. Low levels of VOCs, metals, and BNAs were detected in sediment samples.

Based on the results of a geophysical survey, all anomalies can be accounted for based on surface metal (known as drums and structures). No other anomalies were noted which would indicate additional buried drums.

# Tables

**TABLE 1**
**FINAL GROUNDWATER FIELD PARAMETERS**
**PIER DRUM SITE**
**BRADENTON, FLORIDA**
**JANUARY 1995**

| Well ID | Date Installed | Date developed and Sampled | Parameters | | | | |
|---|---|---|---|---|---|---|---|
| | | | pH | Temperature (C) | Dissolved Oxygen (ppm) | Conductivity (uS/cm) | Turbidity (NTU) |
| MW-N | 1/11/95 | 1/11/95 | 4.58 | 18.7 | 2.3 | 658 | 37.1 |
| MW-S | 1/11/95 | 1/11/95 | 4.68 | 19.1 | 2.2 | 247 | 7.8 |
| MW-E | 1/11/95 | 1/11/95 | 4.97 | 18.8 | 3.3 | 351 | 48.9 |
| MW-W | 1/11/95 | 1/11/95 | 4.52 | 17.8 | 0.7 | 741 | 12 |

NTU = Nephelometric Turbidity Units
$\mu S$ = micro Siemens (10 -6 Siemens)

# TABLE 2
## GROUNDWATER ELEVATION DATA
## PIER DRUM SITE
## BRADENTON, FLORIDA
## JANUARY 1995

| LOCATION | SURFACE ELEVATION (ft) | DEPTH TO WATER (ft) | GROUNDWATER ELEVATION (ft) |
|---|---|---|---|
| MW-N | 99.71 | 1.88 | 97.83 |
| MW-S | 100.45 | 2.58 | 97.87 |
| MW-E | 99.63 | 1.91 | 97.72 |
| MW-W | 100.75 | 2.81 | 97.94 |

All elevations are relative to the site.

## TABLE 3
## CHEMICAL CATEGORIZATION SCREENING
## PIER DRUM SITE
## BRADENTON, FLORIDA
## 10 JANUARY 1995

| ANALAB Sample Number | REAC Sample Number | Florida DEP Number | Drum Type | Liquid | Solid | Flash | pH | H2O Solubility | Reactivity | Specific Gravity | Chlor-Oil-Test | Quanti-Chlor-Test | Spill-FYTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 601 | REAC#1 | 01 | 17E | | X | FLASH | 5 | P | N-C | N/A | N | N/A | N/A |
| 602 | REAC#2 | 02 | 17E | X | | NO-FLASH | 7 | P | N-C | S&F | + | 840-2400 ppm | 4,5,6 |
| 603 | REAC#3 | 03 | 17E | | X | NO-FLASH | 7 | N | N-C | S | N/A | N/A | N/A |
| 604 | REAC#4 | 04 | 17E | X | | NO-FLASH | 7 | T | N-C | N/A | N/A | N/A | N/A |
| 605 | REAC#5 | 05 | 17E | | X | NO-FLASH | N/A | N | N-C | F | N/A | N/A | N/A |
| 606 | REAC#6 | 06 | 17E | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| [illegible] | REAC#7 | 07 | 17E | | X | NO-FLASH | 7 | N | N-C | N/A | N/A | N/A | N/A |
| [illegible] | REAC#8 | 08 | 17E | | X | NO-FLASH | 7 | P | N-C | S | N/A | N/A | N/A |
| [illegible] | REAC#9 | 09 | 17E | X | X | NO-FLASH | 7 | T | Cloudy White | N/A | N/A | N/A | N/A |
| 610 | REAC#10 | 10 | 17E | | X | NO-FLASH | 7 | N | N-C | S | N/A | N/A | N/A |
| [illegible] | REAC#11 | 11 | 17E | | X | FLASH | 7 | N | N-C | S | N/A | N/A | N/A |
| 612 | REAC#12 | 12 | 17E | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 613 | REAC#13 | 13 | 17E | | X | NO-FLASH | 7 | N | N-C | N/A | N/A | N/A | N/A |
| [illegible] | REAC#14 | 14 | 17E | | X | NO-FLASH | 7 | N | N-C | F | N/A | N/A | N/A |
| 615 | REAC#15 | 15 | 17E | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 616 | REAC#16 | 16 | 17E | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

DEP = Department of Environmental Protection
N/A = Non Applicable
N-C = No Change
S = Sinks, F = Floats
4 = Organic Solvent, Petroleum, Distillate Risk; 5 = Iodine, Bromine, Chlorine Risk
T = Total Solubility; P = Parcial Solubility; N = No Solubility
NOTE: Drums #6, #15, #16 could not be opened, and drum #12 was determined to have the same contents as drum #10.

**TABLE 4**
**DRUM SAMPLE COMPOSITE SCHEME**
**PIER DRUM SITE**
**BRADENTON, FLORIDA**
**JANUARY, 1995**

| Composing Scheme | | | |
|---|---|---|---|
| Composite ID | Original Sample ID | Sample Phase | Analysis |
| 00912 | REAC #9* | liquid | Disposal & TCL/TAL |
| 00913 | REAC #2 | liquid | Disposal & TCL/TAL |
| 00914 | REAC #4 | liquid | Disposal & TCL/TAL |
| 00911 | REAC #1,8,9*,11 | solid | TCL (TCLP) |
| 00915 | REAC #5 | solid | TCL (TCLP) |
| 00916 | REAC #3,7,10,13,14 | solid | TCL (TCLP) |

* Drum #9 had both a liquid and a solid layer
Disposal Parameters include: % moisture, % sulfur, % chloride, BTU, Ash content
TCL – refers to the Target Compound List for VOC, BNA, and Pest/PCB
TAL – refers to the Target Analyte List for metals

**TABLE 5**
**SUMMARY OF RESULTS FOR DRUM LIQUID COMPOSITE SAMPLES**
**PIER DRUM SITE**
**BRADENTON, FLORIDA**
**JANUARY 1995**

| SAMPLE ID | 00912 | | 00913 | | 00914 | |
|---|---|---|---|---|---|---|
| SAMPLE LOCATION | REAC#9 | | REAC#2 | | REAC#4 | |
| PARAMETER | Conc µg/L | MDL µg/L | Conc µg/L | MDL µg/L | Conc µg/L | MDL µg/L |
| *METALS* | | | | | | |
| Aluminum | 690 | 100 | ND | 100 | 25000 | 100 |
| Arsenic | ND | 10 | ND | 10 | 22 | 10 |
| Barium | 29 | 10 | 23 | 10 | 240 | 10 |
| Cadmium | 7.0 | 4.0 | 34 | 4.0 | ND | 4.0 |
| Calcium | 410* | 0.20* | 400* | 0.20* | 37* | 0.20* |
| Chromium | 80 | 10 | 120 | 10 | 47 | 10 |
| Cobalt | 7300 | 10 | 40000 | 10 | 900 | 10 |
| Copper | 520 | 10 | 150 | 10 | 660 | 10 |
| Iron | 18* | 0.05* | 360* | 0.05* | 310* | 0.05* |
| Lead | 61 | 10 | 1200 | 10 | 38 | 10 |
| Magnesium | 8000 | 1000 | 8000 | 1000 | 10000 | 1000 |
| Manganese | 3000 | 4.0 | 5700 | 4.0 | 1500 | 4.0 |
| Nickel | 66 | 20 | 850 | 20 | 30 | 20 |
| Potassium | 12000 | 4000 | 35000 | 4000 | 12000 | 4000 |
| Sodium | 21000 | 1000 | 71000 | 1000 | 29000 | 1000 |
| Vanadium | ND | 10 | ND | 10 | 32 | 10 |
| Zinc | 1900 | 10 | 3600 | 10 | 330 | 10 |
| *PEST/PCB's* | | | | | | |
| a-BHC | 0.16 | 0.11 | ND | 0.11 | ND | 0.11 |
| Aldrin | ND | 0.11 | 0.18 | 0.11 | ND | 0.11 |
| *VOC's* | | | | | | |
| Acetone | 130000* | 10* | 230000* | 10* | 14000* | 20* |
| 2-Butanone | ND | 20000 | ND | 20000 | 89000 | 4000 |
| Benzene | 11000 | 5000 | 12000 | 5000 | ND | 1000 |
| Toluene | 5400 | 5000 | 4100J | 5000 | 9600 | 1000 |
| Ethylbenzene | 21000 | 5000 | 88000 | 5000 | 37000 | 1000 |
| p&m Xylene | 16000 | 5000 | 51000 | 5000 | ND | 1000 |
| o-Xylene | 8400 | 5000 | ND | 5000 | 800J | 1000 |
| Styrene | 1200000 | 5000 | 16000000 | 5000 | 26000 | 1000 |
| Isopropylbenzene | 6500 | 5000 | 21000 | 5000 | ND | 1000 |
| n-Propylbenzene | 7600 | 5000 | 17000 | 5000 | ND | 1000 |
| 1,2,4-Trimethylbenzene | 17000 | 5000 | 23000 | 5000 | 45000 | 1000 |
| Naphthalene | 3400J | 5000 | ND | 5000 | 7200 | 1000 |

MDL = Method Detection Limit
ND = Not Detected
* = Concentration and MDL reported in milligram per liter (mg/L)
NOTE: Mercury analysis was not performed due to insufficient sample size.

**TABLE 6**
**RESULTS OF ANALYSIS FOR DISPOSAL CHARACTERISTICS ON DRUM LIQUIDS**
**PIER DRUM SITE**
**BRADENTON, FLORIDA**
**J[illegible]**

| Parameter | Composite ID REAC # 9 ID # 00912 | REAC # 2 ID # 00913 | REAC # 4 ID # 00914 |
|---|---|---|---|
| Heat Value (BTU/lb) | 3379 | 5470 | +50 |
| Percent Ash Content | 0.2 | 0.26 | +0.1 |
| Percent Chloride | 0.33 | 0.34 | 0.44 |
| Percent Sulfur | +0.1 | +0.10 | 0.10 |
| Percent Moisture Content | 53.0 | 9.4 | 89.6 |

**TABLE 7**
**SUMMARY OF TCLP ANALYSES RESULTS FOR DRUM SOLIDS**
**PIER DRUM SITE**
**BRADENTON, FLORIDA**
**JANUARY 1995**

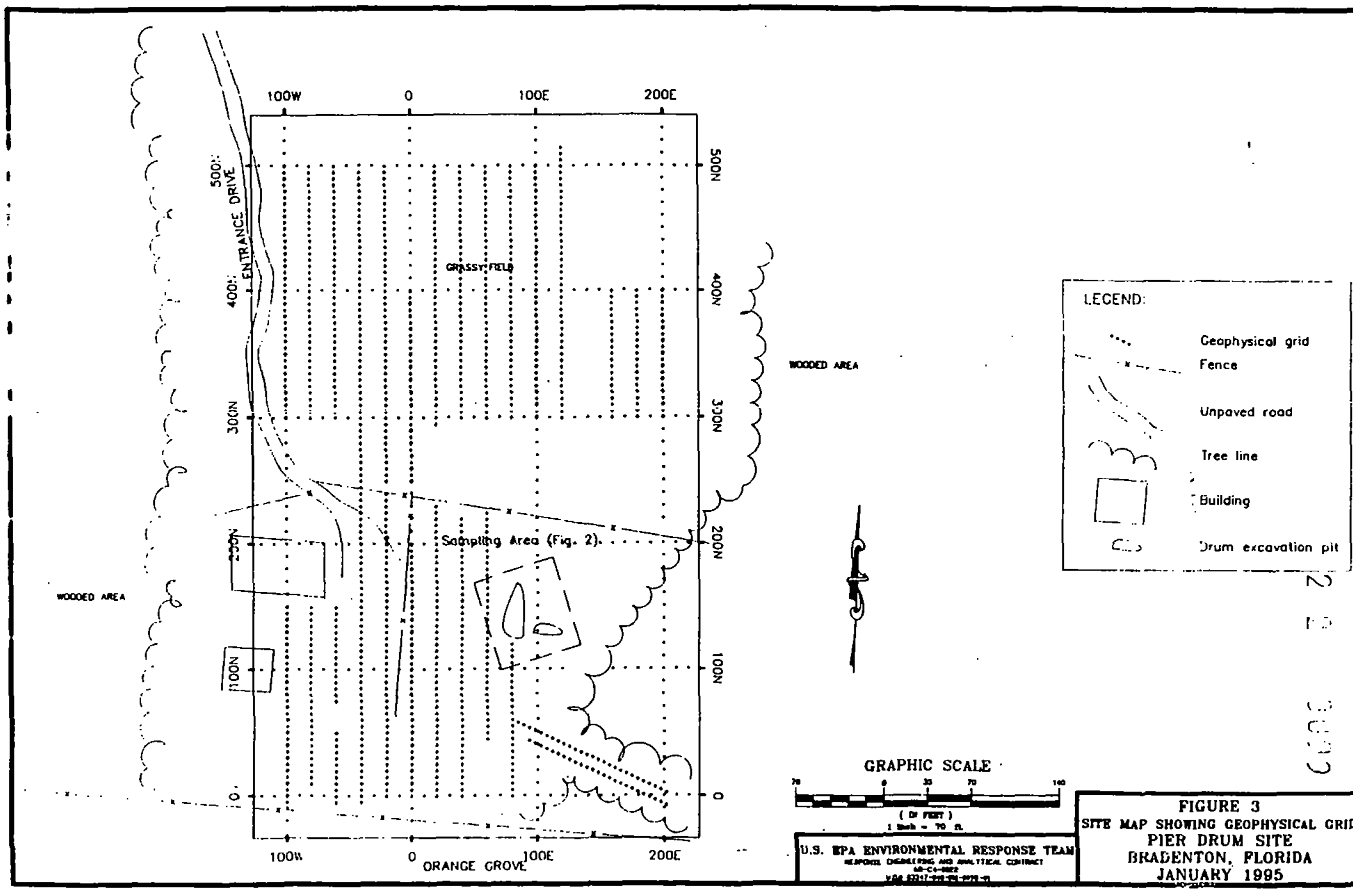
| SAMPLE NUMBER | 00911 | | 00915 | | 00916 | |
|---|---|---|---|---|---|---|
| SAMPLE LOCATION | REAC# 1,8,9,11 | | REAC#5 | | REAC#3,7,10,13,14 | |
| PARAMETER | CONC µg/L | MDL µg/L | CONC µg/L | MDL µg/L | CONC µg/L | MDL µg/L |
| ***BNA's*** | | | | | | |
| Benzyl Alchohol | 1000 | 20 | 83 | 20 | 150 | 20 |
| Benzoic Acid | 120 | 20 | 270 | 20 | 4800E | 20 |
| Di-n-butyl phthalate | 40 | 20 | 34 | 20 | 9J | 20 |
| phenol | 110 | 20 | 17J | 20 | 34 | 20 |
| 2-Methylphenol | 860 | 20 | ND | 20 | ND | 20 |
| ***METALS*** | | | | | | |
| Cadmium | 167 | 80 | ND | 4 | ND | 4 |
| Calcium | 435000 | 2500 | 2800 | 250 | 1290 | 250 |
| Cobalt | 470 | 250 | ND | 250 | ND | 250 |
| Copper | ND | 50 | ND | 50 | 50 | 50 |
| Iron | 2190 | 200 | ND | 200 | 760 | 200 |
| Lead | 102 | 20 | 7.9 | 5 | 6.1 | 5 |
| Magnesium | 4300 | 500 | 300 | 50 | 170 | 50 |
| Manganese | 350 | 100 | ND | 100 | ND | 100 |
| Potassium | 4200 | 1000 | 1580 | 100 | 570 | 100 |
| Sodium | 3100000 | 500000 | 2300000 | 500000 | 1800000 | 500000 |
| Zinc | 440 | 50 | 210 | 50 | 130 | 50 |
| ***PEST/PCB's*** | | | | | | |
| BHC-delta | 0.6 | 0.18 | ND | 0.11 | ND | 0.25 |
| Endosulfan-alpha | ND | 0.18 | ND | 0.11 | 1.0 | 0.25 |
| ***VOC's*** | | | | | | |
| Acetone | 1300000D | 5000 | 11000J | 5000 | ND | 2500 |
| Styrene | 6100 | 5000 | 130000 | 2000 | 40000 | 2500 |

MDL = Method Detection Limit
ND = Not Detected
E = Exceeds calibration range, estimated value
J = Detected Below Detection Limit

TABLE 8
SUMMARY OF GROUNDWATER WELL SAMPLE RESULTS
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

| SAMPLE NUMBER | | 00638 | | 00641 | | 00635 | | 00[illegible] | | 00037 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE LOCATION | | MW-S-DUP | | MW-N | | MW-S | | MW-[illegible] | | MW-E | |
| | MCL | CONC | MDL | CONC | MDL | CONC | MDL | CONC | MDL | CONC | MDL |
| PARAMETER | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L |
| ***BNA's*** | | | | | | | | | | | |
| Di-n-butylphthalate | NEL | 1J,B | 10.0 | 50B | 11.0 | 2J,B | 10.0 | 66B | 11.0 | 1J,B | 11.0 |
| ***METALS (UNFILTERED)*** | | | | | | | | | | | |
| Aluminum | NEL | 1200 | 40.0 | 16000 | 40 | 1400 | 40 | 7400 | 40 | 10000 | 40 |
| Arsenic | 50 | 3.5 | 2.2 | 12.0 | 2.2 | 3.0 | 2.2 | 10.0 | 2.2 | 19.0 | 2.2 |
| Barium | 2000 | 18 | 4.0 | 44.0 | 4.0 | 18.0 | 4.0 | 30.0 | 4.0 | 39.0 | 4.0 |
| Calcium | NEL | 4000 | 100 | 2300 | 100 | 4100 | 100 | 27000 | 100 | 5800 | 100 |
| Chromium | 100 | ND | 2.8 | 16.0 | 2.8 | ND | 2.8 | 7.6 | 2.8 | 13.0 | 2.8 |
| Iron | NEL | 9400 | 10 | 4100 | 10 | 9200 | 10 | 6600 | 10 | 4500 | 10 |
| Lead | 15 | ND | 2.2 | 3.0 | 2.2 | ND | 2.2 | ND | 2.2 | 3.2 | 2.2 |
| Magnesium | NEL | 4200 | 500 | 1400 | 500 | 4300 | 500 | 13000 | 500 | 5800 | 500 |
| Manganese | NEL | 4 | 2.0 | 5.0 | 2.0 | 3.0 | 2.0 | 6.0 | 2.0 | 8.0 | 2.0 |
| Potassium | NEL | ND | 2000 | ND | 2000 | ND | 2000 | 2100 | 2000 | ND | 2000 |
| Sodium | *160000 | 29000 | 500 | 3800 | 500 | 30000 | 500 | 75000 | 500 | 40000 | 500 |
| Vanadium | NEL | ND | 5.0 | 25.0 | 5.0 | ND | 5.0 | 12.0 | 5.0 | 11.0 | 5.0 |
| Zinc | NEL | ND | 5.0 | ND | 5.0 | ND | 5.0 | ND | 5.0 | ND | 5.0 |
| ***METALS (FILTERED)*** | | | | | | | | | | | |
| Aluminum | NEL | 1000 | 40 | 3400 | 40 | 1100 | 40 | 3500 | 40 | 4100 | 40 |
| Arsenic | 50 | 3.3 | 2.2 | 10.0 | 2.2 | 2.8 | 2.2 | 10.0 | 2.2 | 15.0 | 2.2 |
| Barium | 2000 | 17 | 4 | 4.0 | 4.0 | 17.0 | 4.0 | 10.0 | 4.0 | 9.0 | 4.0 |
| Calcium | NEL | 4000 | 100 | 1700 | 100 | 4100 | 100 | 28000 | 100 | 6000 | 100 |
| Chromium | 100 | ND | 2.8 | ND | 2.8 | ND | 2.8 | 3.8 | 2.8 | 3.5 | 2.8 |
| Iron | NEL | 9100 | 10 | 1700 | 10 | 9200 | 10 | 5800 | 10 | 3600 | 10 |
| Lead | 15 | ND | 2.2 | ND | 2.2 | ND | 2.2 | ND | 2.2 | ND | 2.2 |
| Magnesium | NEL | 4100 | 500 | 870 | 500 | 4200 | 500 | 13000 | 500 | 5600 | 500 |
| Manganese | NEL | 3 | 2.0 | ND | 2.0 | 3.0 | 2.0 | 3.0 | 2.0 | 5.0 | 2.0 |
| Potassium | NEL | ND | 2000 | ND | 2000 | ND | 2000 | ND | 2000 | ND | 2000 |
| Sodium | *160000 | 29000 | 500 | 3000 | 500 | 30000 | 500 | 76000 | 500 | 40000 | 500 |
| Vanadium | NEL | ND | 5.0 | 9.0 | 5.0 | ND | 5.0 | 7.0 | 5.0 | ND | 5.0 |
| Zinc | NEL | ND | 5.0 | ND | 5.0 | ND | 5.0 | 5.0 | 5.0 | ND | 5.0 |
| ***PEST/PCB's*** | NA | No Analytes Were Detected. | | | | | | | | | |
| ***VOC's*** | | | | | | | | | | | |
| Acetone | NEL | 6.2 | 2.0 | 3.4 | 2.0 | 7.5 | 2.0 | 3.7 | 2.0 | 8.0 | 2.0 |
| Methyl-tertiary-butylether | NEL | ND | 1.0 | 14.0 | 1.0 | ND | 1.0 | ND | 1.0 | ND | 1.0 |
| Toluene | 1000 | ND | 1.0 | ND | 1.0 | ND | 1.0 | ND | 1.0 | 2.2 | 1.0 |

MCL = Maximum Contaminant Level
NOTE: All established MCLs reported indicate Florida State and Federal Regulations.
NEL = No Established MCL
*Florida State Department of Protection MCL
MDL = Method Detection Limit
ND = Not Detected
B = Compound found in blank
J = Detected below detection limit




U.S. EPA ENVIRONMENTAL RESPONSE TEAM

FIGURE 3
SITE MAP SHOWING GEOPHYSICAL GRID
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

**TABLE 9**
**SUMMARY OF SURFACE WATER SAMPLE RESULTS**
**PIER DRUM SITE**
**BRADENTON, FLORIDA**
**JANUARY 1995**

| SAMPLE NUMBER | | 00639 | | 00638 | |
|---|---|---|---|---|---|
| SAMPLE LOCATION | | W-PIT | | N-PIT | |
| | MCL | CONC | MDL | CONC | MDL |
| PARAMETER | µg/L | µg/L | µg/L | µg/L | µg/L |
| ***BNA's*** | | | | | |
| Di-n-butylphthalate | NEL | 47B | 10 | 38B | 11 |
| ***METALS (UNFILTERED)*** | | | | | |
| Aluminum | NEL | 2000 | 40 | 2300 | 40 |
| Arsenic | 50 | 10.0 | 2.2 | 30 | 2.2 |
| Barium | 2000 | 9.0 | 4.0 | 20 | 4 |
| Calcium | NEL | 12000 | 100 | 17000 | 100 |
| Chromium | 100 | 3.6 | 2.8 | 8.6 | 2.8 |
| Iron | NEL | 1600 | 10 | 950 | 10 |
| Lead | 15 | ND | 2.2 | ND | 2.2 |
| Magnesium | NEL | 4600 | 500 | 6500 | 500 |
| Manganese | NEL | 26.0 | 2.0 | 18 | 2.0 |
| Potassium | NEL | 2300 | 2000 | 4900 | 2000 |
| Sodium | *160000 | 30000 | 500 | 25000 | 500 |
| Vanadium | NEL | 8.0 | 5.0 | 7 | 5 |
| Zinc | NEL | 56.0 | 5.0 | 27 | 5 |
| ***METALS (FILTERED)*** | | | | | |
| Aluminum | NEL | 1400 | 40 | 870 | 40 |
| Arsenic | 50 | 9.6 | 2.2 | 29 | 2.2 |
| Barium | 2000 | 7.0 | 4.0 | 10 | 4 |
| Calcium | NEL | 9800 | 100 | 16000 | 100 |
| Chromium | 100 | 2.9 | 2.8 | 4.5 | 2.8 |
| Iron | NEL | 1100 | 10 | 560 | 10 |
| Lead | 15 | ND | 2.2 | ND | 2.2 |
| Magnesium | NEL | 3600 | 500 | 5800 | 500 |
| Manganese | NEL | 21.0 | 2.0 | 13 | 2 |
| Potassium | NEL | ND | 2000 | 4400 | 2000 |
| Sodium | *160000 | 23000 | 500 | 23000 | 500 |
| Vanadium | NEL | 6.0 | 5.0 | ND | 5.0 |
| Zinc | NEL | 45.0 | 5.0 | 25 | 5.0 |
| ***PEST/PCB's*** | NA | No Analytes Were Detected. | | | |
| ***VOC's*** | | | | | |
| Acetone | NEL | 7.3 | 2.0 | ND | 2 |

MCL = Maximum Contaminant Level
NOTE: All MCL reported are for Florida State and Federal Regulations unless otherwise noted.
NEL = No Established MCL
*Florida State Department of Protection MCL
MDL = Method Detection Limit
ND = Not Detected
B = Compound found in blank
J = Detected below detection limit

TABLE 10
SUMMARY OF RESULTS FOR SEDIMENT SAMPLES
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

2 2 3101

| SAMPLE NUMBER | A00642 | | A00643 | | A00644 | |
|---|---|---|---|---|---|---|
| SAMPLE LOCATION | SED-S | | SED-N | | SED-E | |
| PARAMETER | CONC µg/Kg | MDL µg/Kg | CONC µg/Kg | MDL µg/Kg | CONC µg/Kg | MDL µg/Kg |
| *BNA's* | | | | | | |
| Benzyl Alcohol | ND | 407 | ND | 398 | ND | 402 |
| Diethylphthalate | 87J | 407 | ND | 398 | ND | 402 |
| Di-n-butylphthalate | 2765B | 407 | 3029B | 398 | 1581B | 402 |
| Butylbenzylphythalate | 179J,B | 407 | 156J,B | 398 | ND | 402 |
| Bis(2-Ethylhexyl)phthalate | 338J,B | 407 | ND | 398 | 39J,B | 402 |
| *METALS* | | | | | | |
| Aluminum | 660000 | 9400 | 470000 | 8900 | 330000 | 9300 |
| Barium | 4700 | 3800 | 3600 | 3600 | ND | 3700 |
| Calcium | 290000 | 47000 | 94000 | 45000 | 61000 | 47000 |
| Chromium | 1400 | 800 | ND | 700 | ND | 700 |
| Iron | 200000 | 8400 | 150000 | 8000 | 4300 | 8400 |
| Sodium | 69000 | 47000 | 63000 | 45000 | 93000 | 47000 |
| Zinc | 5400 | 1900 | ND | 1800 | 3400 | 1900 |
| *PEST/PCB's* | No Analytes Were Detected | | | | | |
| *VOC's* | | | | | | |
| Acetone | 207 | 2.5 | ND | 2.5 | ND | 2.5 |
| Methyl-tertiary-butylether | ND | 1.3 | ND | 1.2 | ND | 1.3 |
| Toluene | 12 | 1.3 | 0.9J | 1.2 | ND | 1.3 |
| Ethylbenzene | 670 | 1.3 | ND | 1.2 | ND | 1.3 |
| o-Xylene | 2.4 | 1.3 | ND | 1.2 | ND | 1.3 |
| Styrene | 2.8 | 1.3 | ND | 1.2 | ND | 1.3 |
| Isopropylbenzene | 2.1 | 1.3 | ND | 1.2 | ND | 1.3 |
| n-Propylbenzene | 1.6 | 1.3 | ND | 1.2 | ND | 1.3 |
| 1,2,4-Trimethylbenzene | 3.3 | 1.3 | ND | 1.2 | ND | 1.3 |

MDL = Method Detection Limit
ND = Not Detected
J = Compound Detected Below Method Detection Limit

**TABLE 11**
**SUMMARY OF TCLP ANALYSES RESULTS IN SEDIMENT SAMPLES**
**PIER DRUM SITE**
**BRADENTON, FLORIDA**
**JANUARY 1995**

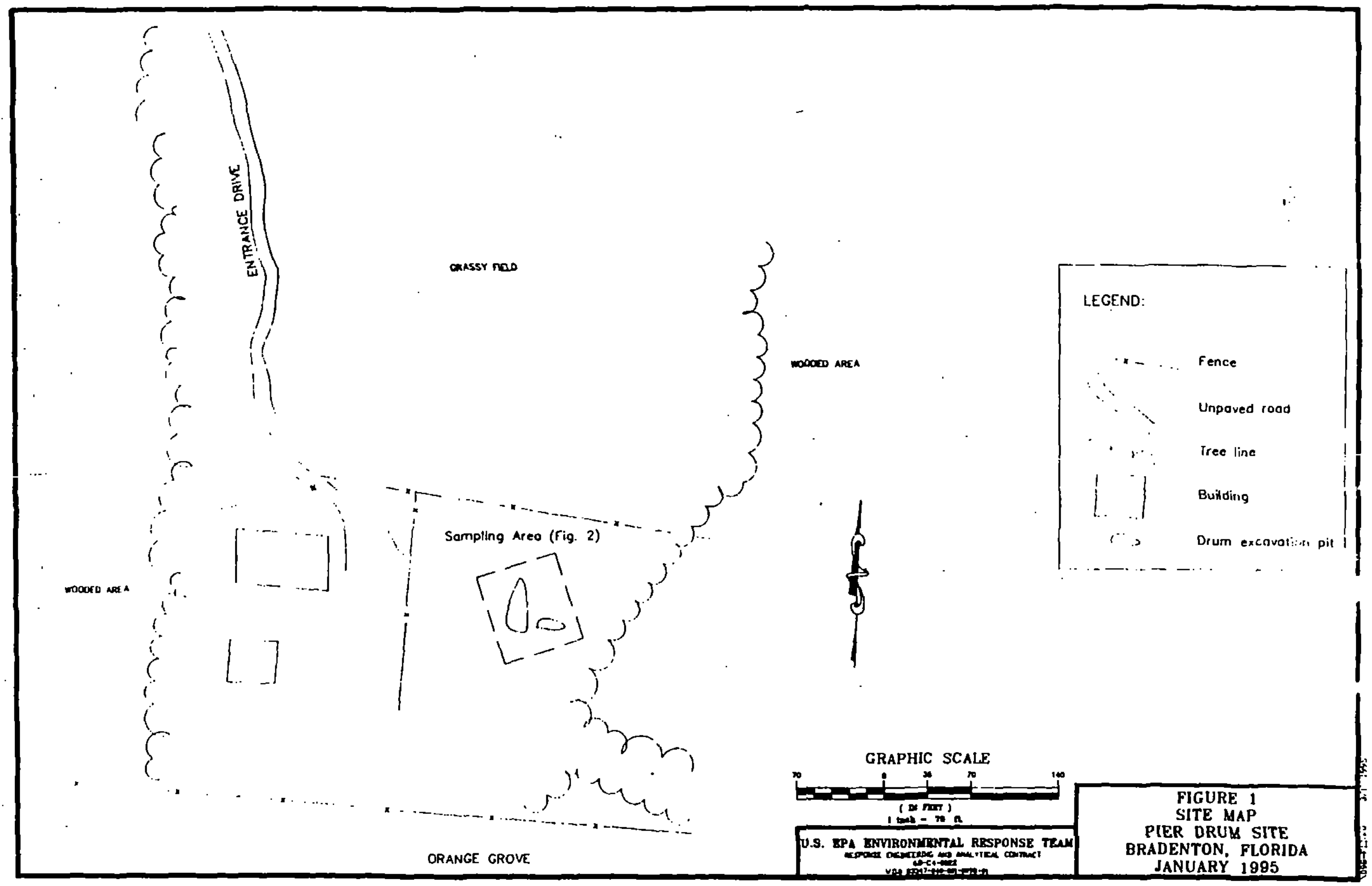
| SAMPLE NUMBER | A00525 | | A00526 | | A,D00527 | |
|---|---|---|---|---|---|---|
| SAMPLE LOCATION | SED-S | | SED-N | | SED-E | |
| | Conc | MDL | Conc | MDL | Conc | MDL |
| PARAMETER | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L |
| ***BNA's*** | | | | | | |
| Benzyl Alcohol | 16 | 13 | 17 | 11 | 15J | 16 |
| Diethylphthalate | 5J | 13 | 2J | 11 | ND | 16 |
| Di-n-butylphthalate | 56B | 13 | 45B | 11 | 91B | 16 |
| Butylbenzylphythalate | ND | 13 | 4J,B | 11 | 2J,B | 16 |
| Bis(2-Ethylhexyl)phthalate | 12J,B | 13 | 11B | 11 | 15J,B | 16 |
| ***METALS*** | | | | | | |
| Arsenic | 6.3 | 2.2 | ND | 2.2 | ND | 2.2 |
| Barium | 930 | 4.0 | 28 | 4.0 | 11 | 4.0 |
| Chromium | 8.0 | 5.0 | ND | 5.0 | ND | 5.0 |
| Lead | 3.2 | 2.2 | ND | 2.2 | ND | 2.2 |
| ***PEST/PCB's*** | No Analytes Were Detected. | | | | | |
| ***VOA's*** | No Analytes Were Detected. | | | | | |

MDL = Method Detection Limit
ND = Not Detected
J = Detected Below Detection Limit
B = Detected in Blank Sample

2 2 0105

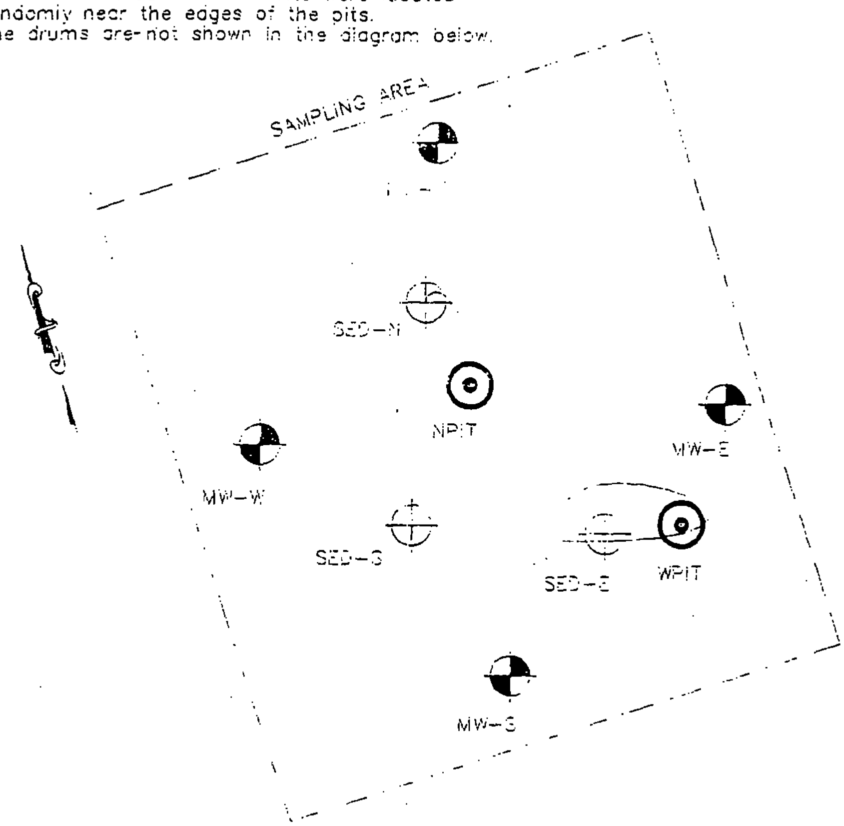


# Figures


ENTRANCE DRIVE
GRASSY FIELD
WOODED AREA
WOODED AREA
Sampling Area (Fig. 2)
ORANGE GROVE
LEGEND:
Fence
Unpaved road
Tree line
Building
Drum excavation pit
GRAPHIC SCALE
70 0 35 70 140
U.S. EPA ENVIRONMENTAL RESPONSE TEAM
FIGURE 1
SITE MAP
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

Note:

Drums excavated from the pits were located randomly near the edges of the pits.
The drums are not shown in the diagram below.




Legend:

Drum excavation pit

Groundwater sample/temporary monitoring well

Sediment sample collected

Surface water sample collected

GRAPHIC SCALE

240 0 120 240

1:240

Figure 2
Sample Locations for Soil
Groundwater and Surfacewater
Pier Drum Site
Bradenton, Florida
January 1995

U.S. EPA ENVIRONMENTAL RESPONSE TEAM
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-C4-0022
V.Z.M. 03347-040-001-0098-2

N098-F2.DWG

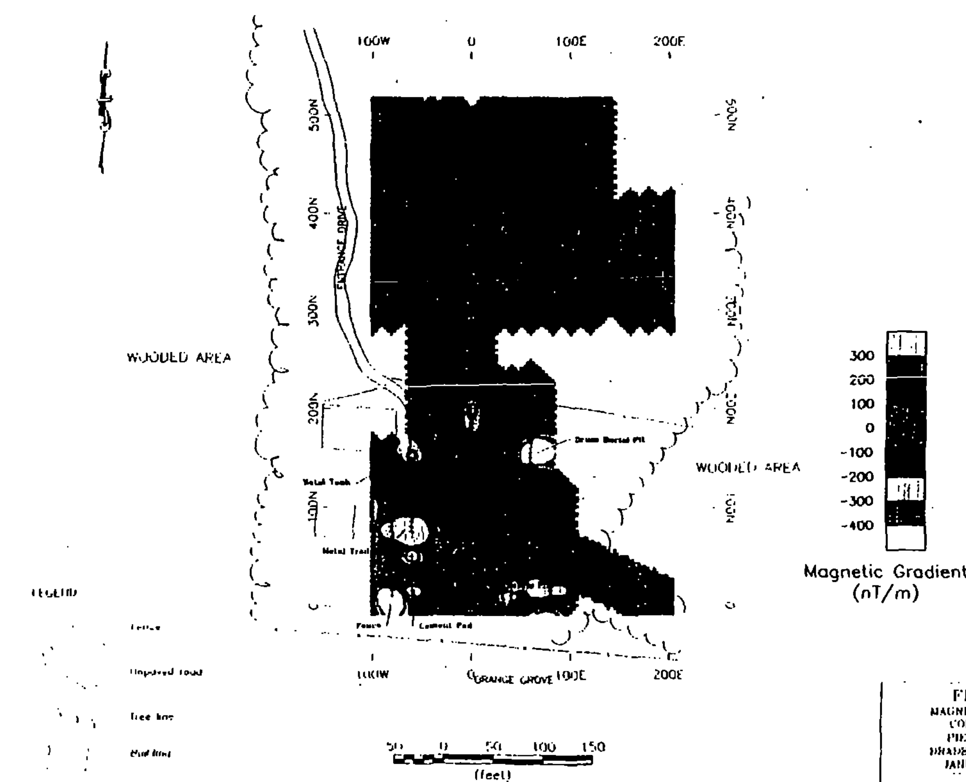



FIGURE 4
MAGNETIC GRADIENT
CONTOUR PLOT
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

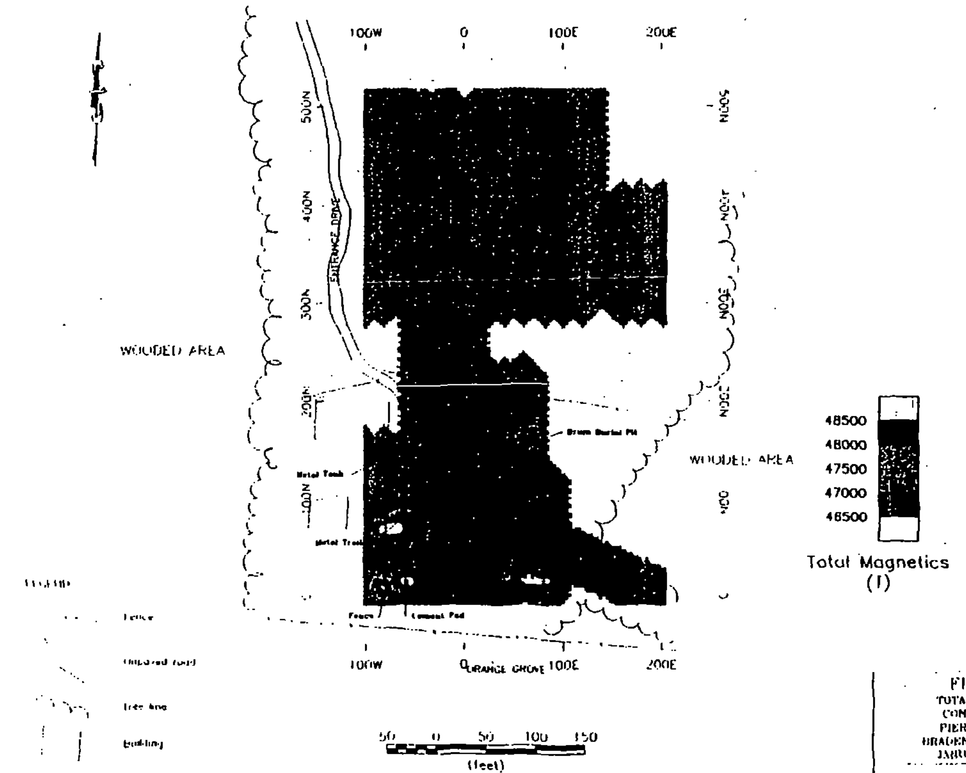



FIGURE 5
TOTAL MAGNETICS
CONTOUR PLOT
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

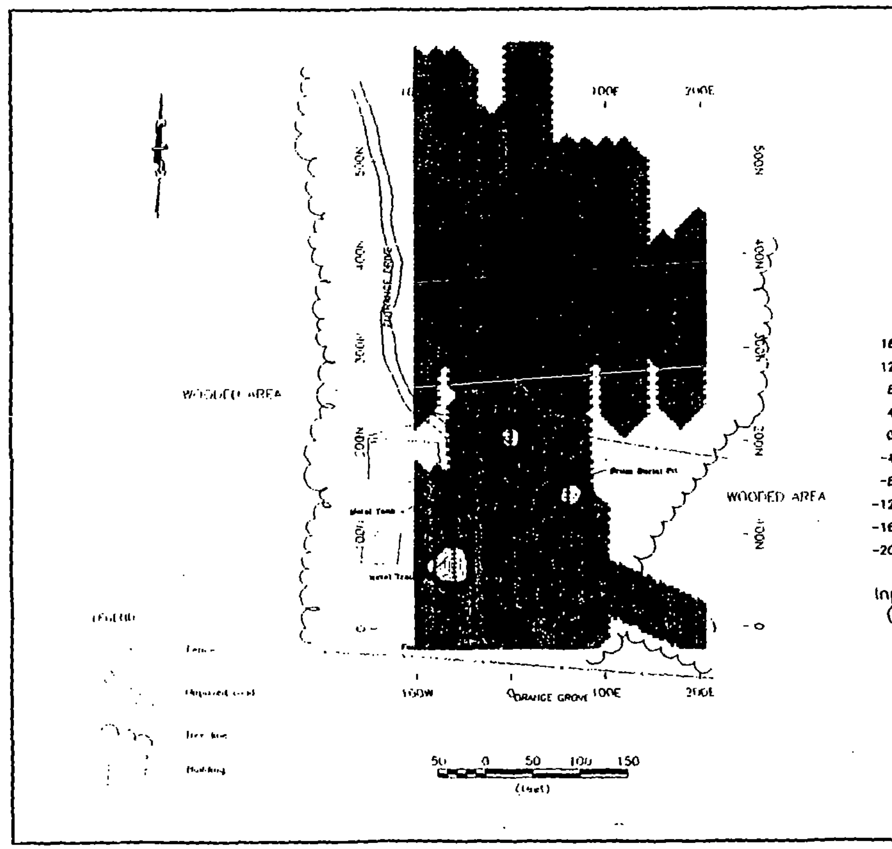



FIGURE 6
ELECTROMAGNETIC INPHASE
CONTOUR PLOT
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

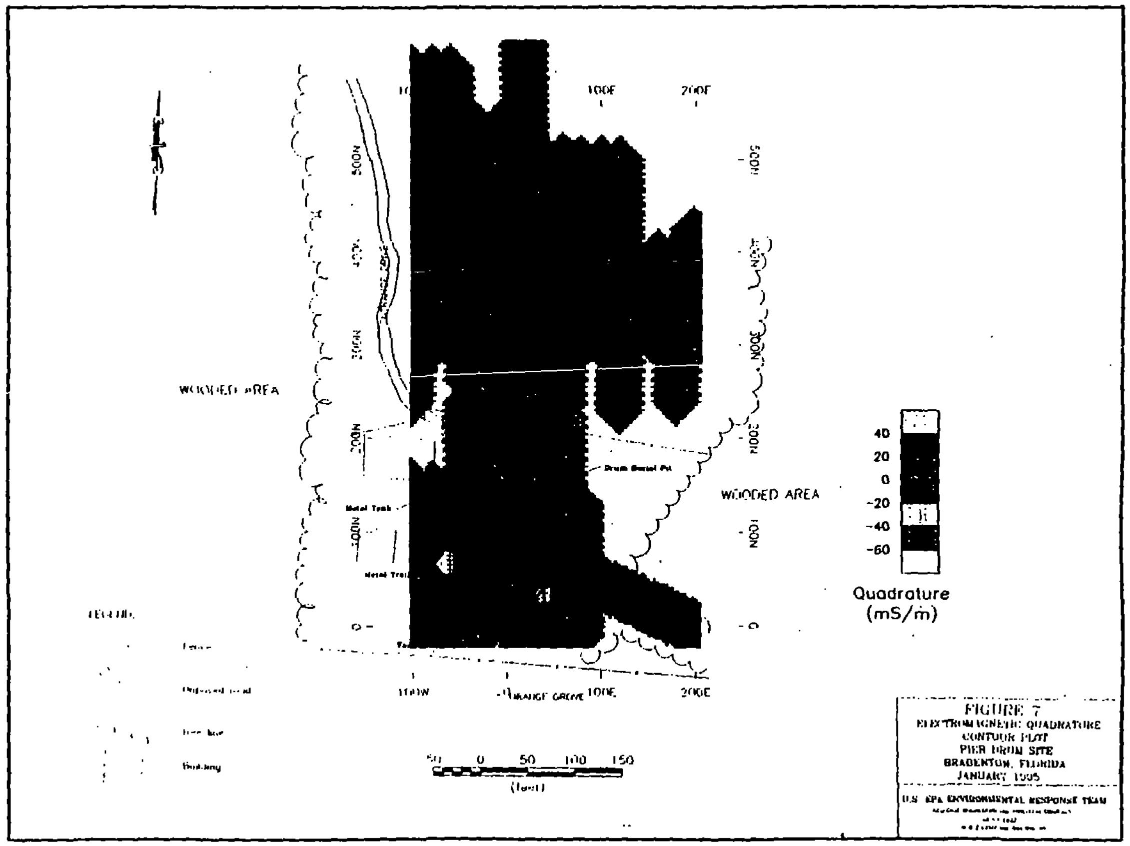



FIGURE 7
ELECTROMAGNETIC QUADRATURE
CONTOUR PLOT
PIER DRUM SITE
BRADENTON, FLORIDA
JANUARY 1995

U.S. EPA ENVIRONMENTAL RESPONSE TEAM

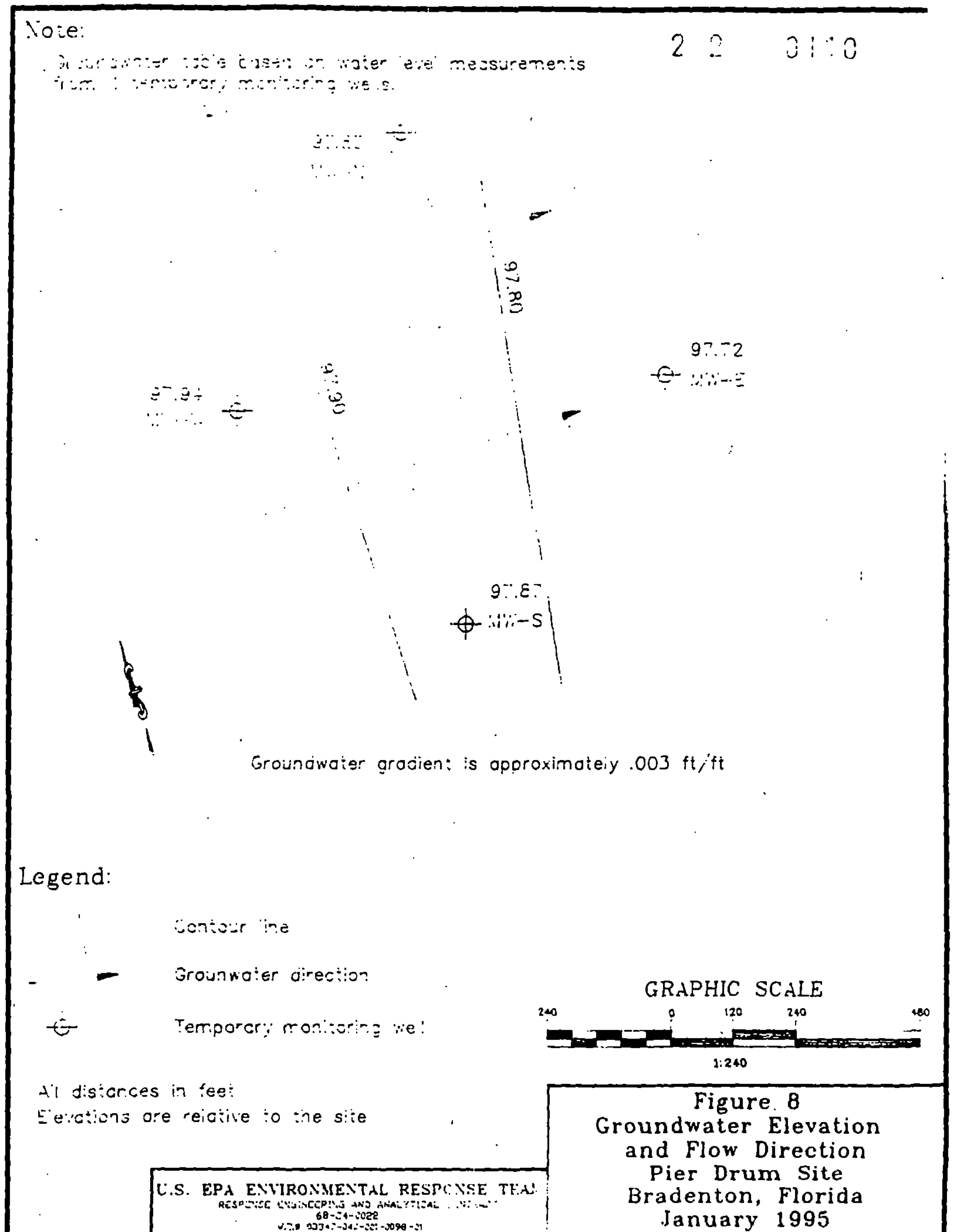



Figure 8
Groundwater Elevation
and Flow Direction
Pier Drum Site
Bradenton, Florida
January 1995

# Appendix A

## APPENDIX A

**SAMPLE DOCUMENTATION**
**Pier Drum Site**
**Bradenton, FL**
**January 1995**

Appendix Contents:

- Field Notes
- Field Data Sheets
- Chain of Custudy Communication

# FIELD DATA SHEET

00634

2 2 0114

**REAC, EDISON, NJ**
**(908) 321-4200**
**EPA CONTRACT 68-C4-0022**

Date 1/11/95 Samplers R. Lewis / Y. Mengesha Site Name: Pier Drum Time 14:55 Sample Location MW-10

Chain of Custody No.: ______
REAC Task Leader: R. Lewis
EPA WAM: Greg Powell
Work Assignment No.: 0098

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ______ | width______ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ______ | depth______ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ______ | velocity___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ______ | pools______% | shell | other ______ |
| hedgerows | floodplain | | color______ | | | riffles ______% | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color______ | pH______ | ambient temp______ |
| groundwater | sludge | trowel | other____ | odor______ | ORP______ | barometric pressure______ |
| potable water | leachate | bucket | | temp______ | salinity______ | relative humidity______ |
| sediment | waste | auger | | DO______ | sample depth____ | weather conditions______ |
| soil | other______ | ekman | | cond______ | tide stage______ | ______ |

ANALYSES TO BE PERFORMED

SAMPLE PREPARATION

| ORGANICS | OTHER ANALYSES | CONTAINER | PRESERVATIVES |
|---|---|---|---|
| A halogenated & aromatic volatiles | A total cyanide | glass jar | $HNO_3$ |
| B volatiles | B. total phenol | plastic jar | NaOH |
| C trihalomethanes | C petroleum hydrocarbons | acetate core | Zn Acetate |
| D pesticides/PCB | D pH | plastic bag | HCl |
| E PCB | E alkalinity | plastic bucket | $Na_2SO_4$ |
| F base neutral/acid extractables | F hardness | other | other ______ |
| G pesticides, drinking water | G total dissolved solids | ______ | |
| H herbicides, drinking water | H total suspended solids | | |
| I other ______ | I sulfate | STORAGE | |
| | J. TOC | wet ice | |
| INORGANICS | K grain size | dry ice | |
| A metals, priority pollutant | L. percent moisture | ambient | |
| B metals, TAL | M other ______ | | |
| C metals scan (ICP) | | | |
| D metals, other ______ | | | |

RCRA
A TCLP
B ignitability
C corrosivity ______ pH____
D reactivity
E other ______

COMMENTS
A - METALS
B - METALS (F)
C - BNA
D - BNA
E - PEST/PCB
E - PEST/PCB

G, H, I - VOA'S

FORM #1

00635

2 2 0115

# FIELD DATA SHEET

**REAC, EDISON, NJ**
**(908) 321-4200**
**EPA CONTRACT 68-C4-0022**

Date: 1/11/95
Time: 1453
Samplers: ~~MW-S~~ R. Lewis / S. Getty
Site Name: Pier Drum [illegible]
Sample Location: MW - S

Chain of Custody No.: 
REAC Task Leader: R. Lewis
EPA WAM: G. Powell
Work Assignment No.: 0098

---

**SITE DESCRIPTION**
landfill, old field, upland palustrine, industrial, wooded, lowland riverine, commercial, farmland, lacustrine, residential, gully, hedgerows, floodplain

**SOIL TYPE**
rock, clay, gravel, muck, sand, loam, silt, peat, color ______

**SURFACE WATER**
color ______, odor ______, flow ______, direction ______

**STREAM**
width ______, depth ______, velocity ___ cm/s, pools ___ %, riffles ___ %

**BOTTOM**
rock, silt, rubble, clay, gravel, organic, shell, other ______, sand

---

**SAMPLE TYPE**
surface water, effluent, groundwater, sludge, potable water, leachate, sediment, waste, soil, other ______

**DEVICE**
kemmerer, ponar, trowel, other ____, bucket, auger, ekman

**SAMPLE INFORMATION**
color ______, pH ______, odor ______, ORP ______, temp ______, salinity ______, DO ______, sample depth ____, cond ______, tide stage ______

**WEATHER PARAMETERS**
ambient temp ______, barometric pressure ______, relative humidity ______, weather conditions ______

---

**ANALYSES TO BE PERFORMED**

**ORGANICS**
A halogenated & aromatic volatiles
B volatiles
C trihalomethanes
D pesticides/PCB
E PCB
F base neutral/acid extractables
G pesticides, drinking water
H herbicides, drinking water
I other ______

**INORGANICS**
A metals, priority pollutant
B metals, TAL
C metals scan (ICP)
D metals, other ______

**RCRA**
A TCLP
B ignitability
C corrosivity ______ pH ____
D reactivity
E other ______

**OTHER ANALYSES**
A. total cyanide
B total phenol
C. petroleum hydrocarbons
D pH
E. alkalinity
F hardness
G total dissolved solids
H total suspended solids
I sulfate
J TOC
K grain size
L. percent moisture
M other ______

**SAMPLE PREPARATION**

**CONTAINER**
glass jar, plastic jar, acetate core, plastic bag, plastic bucket, other ______

**STORAGE**
wet ice, dry ice, ambient

**PRESERVATIVES**
$HNO_3$, NaOH, Zn Acetate, HCl, $Na_2SO_4$, other ______

---

COMMENTS
A - [illegible]
B - [illegible] / F
C - [illegible]
D - [illegible]
E - [illegible] / PCB
F - [illegible] / PCB
G, H, I - [illegible]

FORM #1

# FIELD DATA SHEET

00636

2 2 [illegible]

REAC, EDISON, NJ
(908) 321-4200
EPA CONTRACT 68-C4-0022

Chain of Custody No.: ______
Date 1/11/95 Samplers: K. Lewis
Site Name: [illegible] Drum
Time 15:04 Sample Location: MW - DUP
REAC Task Leader: K. Lewis
EPA WAM: Powell
Work Assignment No.: 0098

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ____ | width ____ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ____ | depth ____ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ____ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ____ | pools ____ % | shell | other ____ |
| hedgerows | floodplain | | color ____ | | | riffles ____ % | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ____ | pH ____ | ambient temp ____ |
| ~~groundwater~~ | sludge | trowel | other ____ | odor ____ | ORP ____ | barometric pressure ____ |
| potable water | leachate | bucket | | temp ____ | salinity ____ | relative humidity ____ |
| sediment | waste | auger | | DO ____ | sample depth ____ | weather conditions ____ |
| soil | other ____ | exman | | cond ____ | tide stage ____ | ____ |

ANALYSES TO BE PERFORMED

SAMPLE PREPARATION

ORGANICS
A halogenated & aromatic volatiles
B volatiles
C trihalomethanes
D. pesticides/PCB
E PCB
F base neutral/acid extractables
G pesticides/ drinking water
H herbicides drinking water
I other ____

INORGANICS
A metals, priority pollutant
B metals, TAL
C metals scan (ICP)
D metals other ____

RCRA
A TCLP
B ignitability
C corrosivity ____ pH ____
D reactivity
E other ____

OTHER ANALYSES
A. total cyanide
B total phenol
C petroleum hydrocarbons
D pH
E alkalinity
F hardness
G total dissolved solids
H total suspended solids
I sulfate
J. TOC
K grain size
L percent moisture
M other ____

CONTAINER
glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other
____

STORAGE
wet ice
dry ice
ambient

PRESERVATIVES
$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_4$
other ____

COMMENTS

A - metals [illegible]
E metals (F)
C,C - B/N
E F - Pest/PCBs
G, H, I - VOAs

FORM #1

00637

# FIELD DATA SHEET

REAC, EDISON, NJ
(908) 321-4200
EPA CONTRACT 68-C4-0022

2 2 0117

Date: 1/13/95 Samplers: R. Lewis Site Name: Pierson Time: 9:54 Sample Location: MWE

Chain of Custody No.: REAC Task Leader: R. Lewis EPA WAM: Powell Work Assignment No.: 098

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ____ | width ____ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ____ | depth ____ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ____ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ____ | pools ____ % | shell | other ____ |
| hedgerows | floodplain | | color ____ | | | riffles ____ % | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ____ | pH ____ | ambient temp ____ |
| groundwater | sludge | trowel | other ____ | odor ____ | ORP ____ | barometric pressure ____ |
| potable water | leachate | bucket | | temp ____ | salinity ____ | relative humidity ____ |
| sediment | waste | auger | | DO ____ | sample depth ____ | weather conditions ____ |
| soil | other ____ | ekman | | cond ____ | tide stage ____ | ____ |

ANALYSES TO BE PERFORMED

SAMPLE PREPARATION

| ORGANICS | OTHER ANALYSES | CONTAINER | PRESERVATIVES |
|---|---|---|---|
| A. halogenated & aromatic volatiles | A. total cyanide | glass jar | $HNO_3$ |
| B. volatiles | B. total phenol | plastic jar | NaOH |
| C. trihalomethanes | C. petroleum hydrocarbons | acetate core | Zn Acetate |
| D. pesticides/PCB | D. pH | plastic bag | HCl |
| E. PCB | E. alkalinity | plastic bucket | $Na_2SO_4$ |
| F. base neutral/acid extractables | F. hardness | other | other ____ |
| G. pesticides, drinking water | G. total dissolved solids | ____ | |
| H. herbicides, drinking water | H. total suspended solids | | |
| I. other ____ | I. sulfate | STORAGE | |
| | J. TOC | wet ice | |
| INORGANICS | K. grain size | dry ice | |
| A. metals, priority pollutant | L. percent moisture | ambient | |
| B. metals, TAL | M. other ____ | | |
| C. metals scan (ICP) | | | |
| D. metals, other ____ | | | |

RCRA
A. TCLP
B. ignitability
C. corrosivity ____ pH ____
D. reactivity
E. other ____

COMMENTS A - Metals
B Metals F
CD - BNA
EF - Pest/PCB
G & I - VOAs

FORM #1

# FIELD DATA SHEET

00638

**REAC, EDISON, NJ**
**(908) 321-4200**
**EPA CONTRACT 68-C4-0022**

2 2 0118

| | | | |
|---|---|---|---|
| Date 1/12/95 | Samplers: R. Lewis | Chain of Custody No.: | |
| | Site Name: Fair Drum | REAC Task Leader: Klewis | |
| Time | Sample Location: NPit | EPA WAM: Powell | |
| | | Work Assignment No.: 0078 | |

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ____ | width____ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ____ | depth____ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ____ | velocity___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ____ | pools____% | shell | other ____ |
| hedgerows | floodplain | | color____ | | | riffles ____% | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color____ | pH____ | ambient temp____ |
| groundwater | sludge | trowel | other____ | odor____ | ORP____ | barometric pressure____ |
| potable water | leachate | bucket | | temp____ | salinity____ | relative humidity____ |
| sediment | waste | auger | | DO____ | sample depth____ | weather conditions____ |
| soil | other____ | ekman | | cond____ | tide stage____ | ____ |

**ANALYSES TO BE PERFORMED**

**ORGANICS**
- A halogenated & aromatic volatiles
- B volatiles
- C trihalomethanes
- D pesticides/PCB
- E. PCB
- F base neutral/acid extractables
- G pesticides, drinking water
- H herbicides, drinking water
- I other ____

**INORGANICS**
- A metals, priority pollutant
- B. metals, TAL
- C metals scan (ICP)
- D metals other ____

**RCRA**
- A TCLP
- B ignitability
- C corrosivity ____ pH____
- D reactivity
- E. other ____

**OTHER ANALYSES**
- A. total cyanide
- B total phenol
- C. petroleum hydrocarbons
- D. pH
- E alkalinity
- F hardness
- G. total dissolved solids
- H total suspended solids
- I sulfate
- J. TOC
- K. grain size
- L. percent moisture
- M other ____

**SAMPLE PREPARATION**

**CONTAINER**
- glass jar
- plastic jar
- acetate core
- plastic bag
- plastic bucket
- other
- ____

**PRESERVATIVES**
- $HNO_3$
- NaOH
- Zn Acetate
- HCl
- $Na_2SO_4$
- other ____

**STORAGE**
- wet ice
- dry ice
- ambient

COMMENTS
C - Metals
E Metals/F?
C,D - BNA
E,F - PCB/Pest
G,H I - VOA's

FORM #1

# FIELD DATA SHEET

**REAC, EDISON, NJ**
**(908) 321-4200**
**EPA CONTRACT 68-C4-0022**

Date: 1/11/95 Samplers: R. Lewis
Site Name: Air Ingram
Time: ________ Sample Location: West Pit (10PIT)

Chain of Custody No.: ________
REAC Task Leader: Ray Lewis
EPA WAM: Gregg Powell
Work Assignment No.: 098

**SITE DESCRIPTION**
landfill, old field, upland palustrine, industrial, wooded, lowland riverine, commercial, farmland, lacustrine, residential, gully, hedgerows, floodplain

**SOIL TYPE**
rock, clay, gravel, muck, sand, loam, silt, peat, color ________

**SURFACE WATER**
color ________, odor ________, flow ________, direction ________

**STREAM**
width ______, depth ______, velocity ___ cm/s, pools ______%, riffles ______%

**BOTTOM**
rock, silt, rubble, clay, gravel, organic, shell, other ________, sand

**SAMPLE TYPE**
surface water, effluent, groundwater, sludge, potable water, leachate, sediment, waste, soil, other ________

**DEVICE**
kemmerer, ponar, trowel, other ____, bucket, auger, ekman

**SAMPLE INFORMATION**
color ________, pH ________, odor ________, ORP ________, temp ________, salinity ________, DO ________, sample depth ____, cond ________, tide stage ______

**WEATHER PARAMETERS**
ambient temp ________, barometric pressure ________, relative humidity ________, weather conditions ________

**ANALYSES TO BE PERFORMED**

**ORGANICS**
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ________

**INORGANICS**
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ________

**RCRA**
A. TCLP
B. ignitability
C. corrosivity ________ pH ____
D. reactivity
E. other ________

**OTHER ANALYSES**
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ________

**SAMPLE PREPARATION**

**CONTAINER**
glass jar, plastic jar, acetate core, plastic bag, plastic bucket, other ________

**PRESERVATIVES**
$HNO_3$, NaOH, Zn Acetate, HCl, $Na_2SO_4$, other ________

**STORAGE**
wet ice, dry ice, ambient

COMMENTS
AE - Metals
CD - ENA
FF - Pest/PCB
GF - VOA

FORM #1

# FIELD DATA SHEET

00640

2 2 0120

REAC, EDISON, NJ
(908) 321-4200
EPA CONTRACT 68-C4-0022

Date: 1/11/95
Time: ______
Samplers: Ray Lewis
Site Name: Pier Drum
Sample Location: Field Blank

Chain of Custody No.: ______
REAC Task Leader: Ray Lewis
EPA WAM: Gregg Powell
Work Assignment No.: 098

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ______ | width ______ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ______ | depth ______ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ______ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ______ | pools ______ % | shell | other ______ |
| hedgerows | floodplain | | color ______ | | | riffles ______ % | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ______ | pH ______ | ambient temp ______ |
| groundwater | sludge | trowel | other ______ | odor ______ | ORP ______ | barometric pressure ______ |
| potable water | leachate | bucket | | temp ______ | salinity ______ | relative humidity ______ |
| sediment | waste | auger | | DO ______ | sample depth ______ | weather conditions ______ |
| soil | other ______ | ekman | | cond ______ | tide stage ______ | ______ |

ANALYSES TO BE PERFORMED

ORGANICS
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ______

INORGANICS
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ______

RCRA
A. TCLP
B. ignitability
C. corrosivity ______ pH ______
D. reactivity
E. other ______

OTHER ANALYSES
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ______

SAMPLE PREPARATION

CONTAINER
glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other
______

STORAGE
wet ice
dry ice
ambient

PRESERVATIVES
$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_3$
other ______

COMMENTS

AB - Metals
CD - BNA
EF - Pest/PCB
GH - VOA's

FORM #1

# FIELD DATA SHEET

00641

2 2 3121

**REAC, EDISON, NJ**
**(908) 321-4200**
**EPA CONTRACT 68-C4-0022**

Chain of Custody No.: ____________

Samplers: Ray Lewis

REAC Task Leader: Ray Lewis

Date: 1/11/95

Site Name: Pier Dock

EPA WAM: Greg Powell

Time: ________

Sample Location: MW-N

Work Assignment No.: 1298

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ______ | width ______ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ______ | depth ______ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ______ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ______ | pools ______ % | shell | other ______ |
| hedgerows | floodplain | | color ______ | | | riffles ______ % | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ______ | pH ______ | ambient temp ______ |
| groundwater | sludge | trowel | other ______ | odor ______ | ORP ______ | barometric pressure ______ |
| potable water | leachate | bucket | | temp ______ | salinity ______ | relative humidity ______ |
| sediment | waste | auger | | DO ______ | sample depth ______ | weather conditions ______ |
| soil | other ______ | ekman | | cond ______ | tide stage ______ | |

## ANALYSES TO BE PERFORMED

### ORGANICS

A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ____________

### INORGANICS

A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ____________

### RCRA

A. TCLP
B. ignitability
C. corrosivity ________ pH ____
D. reactivity
E. other ____________

### OTHER ANALYSES

A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ________

## SAMPLE PREPARATION

### CONTAINER

glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other
________

### PRESERVATIVES

$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_3$
other ________

### STORAGE

wet ice
dry ice
ambient

COMMENTS

FE – [illegible]
CL – [illegible]
EP – [illegible]
[illegible] – [illegible]

FORM #1

00642

3122

# FIELD DATA SHEET

**REAC, EDISON, NJ**
**(908) 321-4200**
**EPA CONTRACT 68-C4-0022**

Date: 1/11/95 Samplers: [illegible] Site Name: Pier Drive Time: ______ Sample Location: SEDS

Chain of Custody No.: ______
REAC Task Leader: Ray Lewis
EPA WAM: Gregg Kozell
Work Assignment No.: 098

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ______ | width ______ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ______ | depth ______ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ______ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ______ | pools ______ % | shell | other ______ |
| hedgerows | floodplain | | color ______ | | | riffles ______ % | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ______ | pH ______ | ambient temp ______ |
| groundwater | sludge | trowel | other ____ | odor ______ | ORP ______ | barometric pressure ______ |
| potable water | leachate | bucket | | temp ______ | salinity ______ | relative humidity ______ |
| sediment | waste | auger | | DO ______ | sample depth ____ | weather conditions ______ |
| soil | other ______ | ekman | | cond ______ | tide stage ______ | ______ |

## ANALYSES TO BE PERFORMED

**ORGANICS**
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides drinking water
H. herbicides drinking water
I. other ______

**INORGANICS**
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ______

**RCRA**
A. TCLP
B. ignitability
C. corrosivity ______ pH ____
D. reactivity
E. other ______

**OTHER ANALYSES**
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ______

## SAMPLE PREPARATION

**CONTAINER**
glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other
______

**PRESERVATIVES**
$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_4$
other ______

**STORAGE**
wet ice
dry ice
ambient

COMMENTS A - all TCL & all TCLP except VOA's
~~C - VOA's~~
C - VOA's (TCLP)
C&E - VOA's

FORM #1

**FIELD DATA SHEET** 00643

REAC, EDISON, NJ
(908) 321-4200
EPA CONTRACT 68-C4-0022

| | | |
|---|---|---|
| Date: 1/11/95 | Samplers: | Chain of Custody No.: |
| | Site Name: Pier Drum | REAC Task Leader: Ray Lewis |
| Time: | Sample Location: SED N | EPA WAM: Gregg Powell |
| | | Work Assignment No.: 098 |

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ______ | width ______ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ______ | depth ______ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ______ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ______ | pools ___ % | shell | other ______ |
| hedgerows | floodplain | | color ______ | | | riffles ___ % | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ______ | pH ______ | ambient temp ______ |
| groundwater | sludge | trowel | other ____ | odor ______ | ORP ______ | barometric pressure ______ |
| potable water | leachate | bucket | | temp ______ | salinity ______ | relative humidity ______ |
| sediment | waste | auger | | DO ______ | sample depth ____ | weather conditions ______ |
| soil | other ______ | ekman | | cond ______ | tide stage ______ | ______ |

ANALYSES TO BE PERFORMED

**ORGANICS**
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ______

**INORGANICS**
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ______

**RCRA**
A. TCLP
B. ignitability
C. corrosivity ______ pH ___
D. reactivity
E. other ______

**OTHER ANALYSES**
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ______

SAMPLE PREPARATION

**CONTAINER**
glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other ______

**STORAGE**
wet ice
dry ice
ambient

**PRESERVATIVES**
$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_3$
other ______

COMMENTS

A – all TCL ; TCLP xcept VOA'S
B – VOA'S TCLP
CDE – VOA'S

FORM #1

# FIELD DATA SHEET

00644

REAC, EDISON, NJ
(908) 321-4200
EPA CONTRACT 68-C4-0022

2 C 0124

Date: 1/11/95 Samplers: Ray Lewis
Time: ___ Site Name: Pier Drum
Sample Location: SED - E

Chain of Custody No.: ___
REAC Task Leader: Ray Lewis
EPA WAM: Gregg Powe
Work Assignment No.: 098

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ___ | width ___ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ___ | depth ___ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ___ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ___ | pools ___% | shell | other ___ |
| hedgerows | floodplain | | color ___ | | | riffles ___% | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ___ | pH ___ | ambient temp ___ |
| groundwater | sludge | trowel | other ___ | odor ___ | ORP ___ | barometric pressure ___ |
| potable water | leachate | bucket | | temp ___ | salinity ___ | relative humidity ___ |
| sediment | waste | auger | | DO ___ | sample depth ___ | weather conditions ___ |
| soil | other ___ | ekman | | cond ___ | tide stage ___ | ___ |

ANALYSES TO BE PERFORMED

SAMPLE PREPARATION

ORGANICS
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ___

INORGANICS
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ___

RCRA
A. TCLP
B. ignitability
C. corrosivity ___ pH ___
D. reactivity
E. other ___

OTHER ANALYSES
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ___

CONTAINER
glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other ___

STORAGE
wet ice
dry ice
ambient

PRESERVATIVES
$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_4$
other ___

COMMENTS
F all TCL & TCLP except VOAs
G - VOAs TCLP
C, D, E - VOAs

FORM #1

00645

2 2 012.

# FIELD DATA SHEET

REAC, EDISON, NJ
(908) 321-4200
EPA CONTRACT 68-C4-0022

Samplers: Ray Lewis
Date: ________ Site Name: Pier Drum
Time: ________ Sample Location: Trip Blank

Chain of Custody No.: ________
REAC Task Leader: Ray Lewis
EPA WAM: Gregg Powell
Work Assignment No.: 028

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ________ | width ______ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odor ________ | depth ______ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ________ | velocity ___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ________ | pools ______ % | shell | other ________ |
| hedgerows | floodplain | | color ________ | | | riffles ______ % | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color ______ | pH ______ | ambient temp ______ |
| groundwater | sludge | trowel | other ____ | odor ______ | ORP ______ | barometric pressure ______ |
| potable water | leachate | bucket | | temp ______ | salinity ______ | relative humidity ______ |
| *sediment* | *waste* | *auger* | | DO ______ | *sample depth* ____ | *weather conditions* ______ |
| soil | other ______ | ekman | | cond ______ | tide stage ______ | ______ |

## ANALYSES TO BE PERFORMED

**ORGANICS**

A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ________

**INORGANICS**

A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals, other ________

**RCRA**

A. TCLP
B. ignitability
C. corrosivity ________ pH ____
D. reactivity
E. other ________

**OTHER ANALYSES**

A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ________

## SAMPLE PREPARATION

**CONTAINER**

glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other ________

**PRESERVATIVES**

$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_4$
other ________

**STORAGE**

wet ice
dry ice
ambient

COMMENTS VOAS

FORM #1

ΦΦ98 Drum Sampling
10 Jan 95
REAC#1
17E Pole 11
Φ1 FLADEP#

The Drm is on its side & is very Damaged.
The Bung is moist & may be c
microtip at Bung 126 ppm
SOLID - Brown 3/4 Full

DRUM/TANK SAMPLING DATA SHEET

2 2 0127

Samplers: Getty & Morganti
Site Name: Pier Drum
Container Number/Sample Number: REAC#1

Date: 10 Jan 95
Work Assignment Number: 3347-04-01-0098
REAC Task Leader: Ray Lewis

SITE INFORMATION:

1. Terrain, drainage description: Flat, roul woods and feilds with sandy soil.
2. Weather conditions (from observation): Mid to high 60's °F and sunny.
   MET station on site: X No, Yes

SAMPLE INFORMATION:

1. Container type: X Drum, Tank, Other:
2. Container dimensions: Shape: 17E ~~in overpak 17H~~ O AM
   Approximate size: 55 gal ~~in 85 gal~~ AM
3. Label present: X No, Yes:
4. Spill or Leak present: X No, Yes, Dimensions:
5. Description: liquid, X solid ( powder or ~~X~~ crystals), sludge Looks
6. Color: Brown , Odor: Yes , Vapors: ~~Yes~~ AM

FIELD TEST DATA SHEET FOR DRUM/TANK SAMPLING

IGNITABILITY ①

Flash X No Flash ____

pH OF AQUEOUS SOLUTION

1. Using 0-14 pH paper, check pH of water/sample solution: 5 pH is of the H₂O used in Solubility Test

WATER SOLUBILITY TEST:

1. Add approximately one part sample to five parts water. You may need to stir and heat gently. [DO NOT HEAT IF WATER REACTIVE!] Results: ____ total, X partial, ____ no solubility.

WATER REACTIVITY:

1. Add small amount of sample to water: ____ bubbles, ____ color change to ________, ____ odor or vapor formation, ____ heat, X No Change.

SPECIFIC GRAVITY TEST (compared to water):

1. Add small amount of sample to water: ____ Sinks, ____ Floats.
2. If liquid sample sinks, screen for chlorinated compounds. If liquid sample floats and appears to be oily, screen for PCB's (Chlor n Oil kit).

CHLOR N OIL TEST KIT INFORMATION:

1. Test kit used for this sample: ____ Yes, X No
2. Results: ____ PCB not present; ____ PCB present, less than 50 ppm; ____ PCB present, greater than 50 ppm; ____ 100 % PCB present.

SPILL-FYTER CHEMICAL CLASSIFIER STRIPS:

Results: N/A

COMMENTS

① When the Solid was placed in the Flash tester & heated for 1 min it did Flash.

+ for Action Drager Tube

00601

2 2 0123

# FIELD DATA SHEET

REAC, EDISON, NJ
(908) 321-4200
EPA CONTRACT 68-C4-0022

Chain of Custody No.: 3627
Samplers: Getty & Murguia
REAC Task Leader: Roy Lewis
Date: 10 Jan 95 Site Name: Pier Drum
EPA WAM: Greg Powell
Time: 1300 Sample Location: Sarasota FLA
Work Assignment No.: 3347-4001-0095-01

| SITE DESCRIPTION | | | SOIL TYPE | | SURFACE WATER | STREAM | BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| landfill | old field | upland palustrine | rock | clay | color ______ | width______ | rock | silt |
| industrial | wooded | lowland riverine | gravel | muck | odo: ______ | depth______ | rubble | clay |
| commercial | farmland | lacustrine | sand | loam | flow ______ | velocity___ cm/s | gravel | organic |
| residential | gully | | silt | peat | direction ______ | pools_____% | shell | other ______ |
| hedgerows | floodplain | | color______ | | | riffles _____% | sand | |

| SAMPLE TYPE | | DEVICE | | SAMPLE INFORMATION | | WEATHER PARAMETERS |
|---|---|---|---|---|---|---|
| surface water | effluent | kemmerer | ponar | color______ | pH______ | ambient temp______ |
| groundwater | sludge | trowel | other____ | odor______ | ORP______ | barometric pressure______ |
| potable water | leachate | bucket | | temp______ | salinity______ | relative humidity______ |
| sediment | waste | auger | | DO______ | sample depth____ | weather conditions______ |
| soil | other______ | ekman | | cond______ | tide stage______ | ______ |

ANALYSES TO BE PERFORMED

ORGANICS
A. halogenated & aromatic volatiles
B. volatiles
C. trihalomethanes
D. pesticides/PCB
E. PCB
F. base neutral/acid extractables
G. pesticides, drinking water
H. herbicides, drinking water
I. other ______

INORGANICS
A. metals, priority pollutant
B. metals, TAL
C. metals scan (ICP)
D. metals other ______

RCRA
A. TCLP
B. ignitability
C. corrosivity ______ pH____
D. reactivity
E. other ______

OTHER ANALYSES
A. total cyanide
B. total phenol
C. petroleum hydrocarbons
D. pH
E. alkalinity
F. hardness
G. total dissolved solids
H. total suspended solids
I. sulfate
J. TOC
K. grain size
L. percent moisture
M. other ______

SAMPLE PREPARATION

CONTAINER
glass jar
plastic jar
acetate core
plastic bag
plastic bucket
other
______

PRESERVATIVES
$HNO_3$
NaOH
Zn Acetate
HCl
$Na_2SO_4$
other ______

STORAGE
wet ice
dry ice
ambient

COMMENTS Drum Sample REAC #1
FLA DEP # 1
17E

FORM #1

REAC # 2
17E Puto 12 + 13 - 14
02 FLA DEP #

Dm 7a in Air shape

Markings

DION
Polyester Resin
Koppers Company, Inc
Organic Material Group
Pittsburg, Pa ~~PA~~ 15219

Also contains a Warning lable Photo #14
Stating Contents of Styrene Monomer
250 PPM Microtip Full
LIQUID -> 50%
solid/sludge -> 50%
REDISH Brown Liquid
multi colored sludge

U.S. EPA REGION IV

# SDMS

## Unscannable Material Target Sheet

DocID: 10692457 Site ID: FL0001096718

Site Name: Piers Property

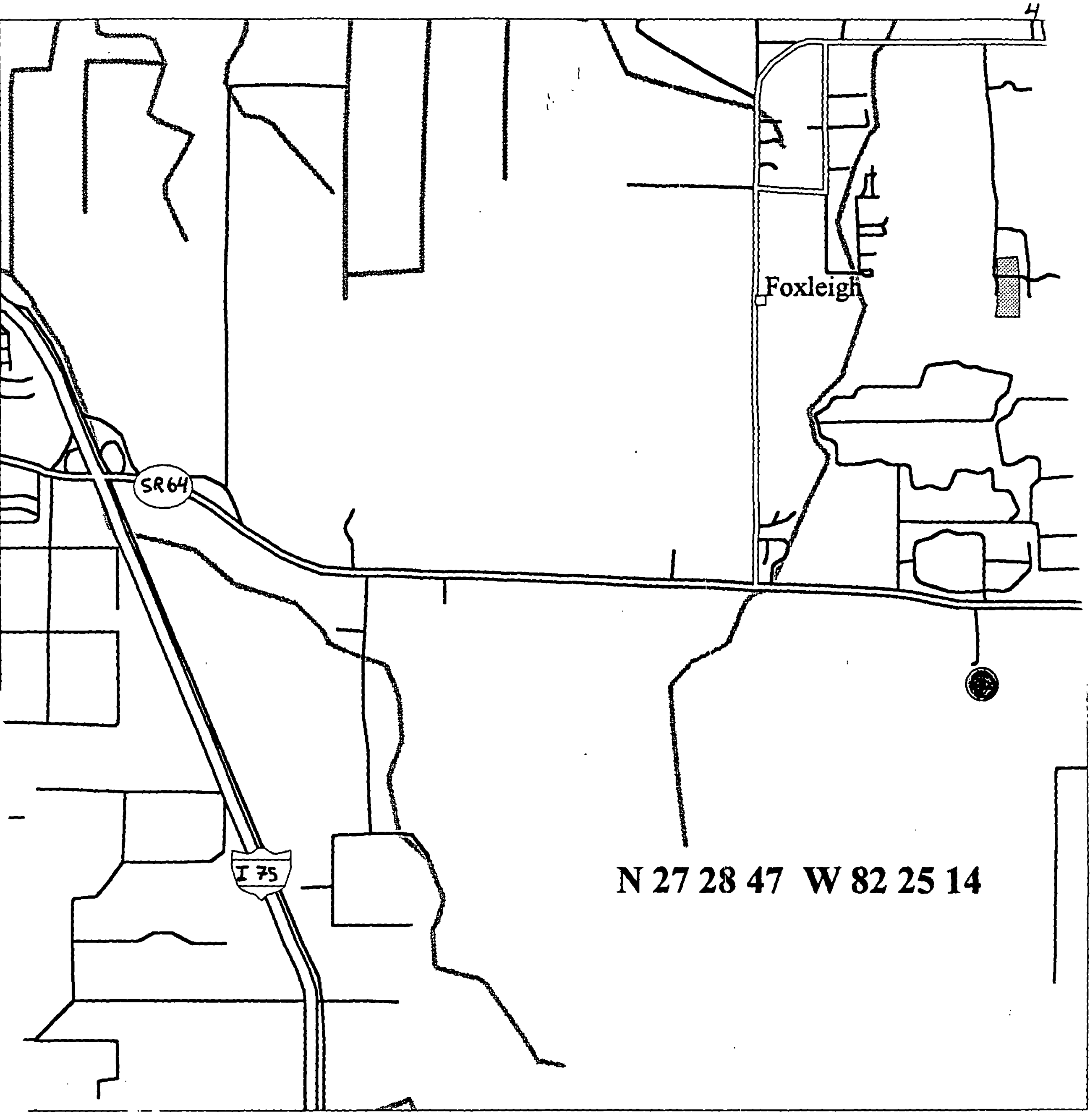
Nature of Material:

| | | | |
|---|---|---|---|
| Map: | ☒ | Computer Disks: | ☐ |
| Photos: | ☐ | CD-ROM: | ☐ |
| Blueprints: | ☐ | Oversized Report: | ☐ |
| Slides: | ☐ | Log Book: | ☐ |

Other (describe): Site Map (Ref. 3)

Amount of material:

* Please contact the appropriate Records Center to view the material *




END

) State Route
Geo Feature
] Interstate, Turnpike
- Street, Road
- Hwy Ramps
, Major Street/Road
, State Route
. Interstate Highway

River
Open Water

Scale 1:31,250 (at center)

2000 Feet

1000 Meters

Mag 13.00
Fri Mar 29 13:08:51 1996

Ref # 5

STATE OF FLORIDA
*STATE BOARD OF CONSERVATION*
Ernest Mitts, Director

FLORIDA GEOLOGICAL SURVEY
Robert O. Vernon, Director

REPORT OF INVESTIGATIONS NO. 21

# THE ARTESIAN WATER OF THE RUSKIN AREA OF HILLSBOROUGH COUNTY, FLORIDA

By
HARRY M. PEEK
U. S. Geological Survey

Prepared by the
UNITED STATES GEOLOGICAL SURVEY
in cooperation with the
FLORIDA GEOLOGICAL SURVEY
and the
BOARD OF COUNTY COMMISSIONERS OF HILLSBOROUGH COUNTY

TALLAHASSEE, FLORIDA
1959

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

# HYDROLOGIC ALMANAC OF FLORIDA

By Richard C. Heath and Clyde S. Conover

---

Open-File Report 81-1107

Prepared in cooperation with the

FLORIDA DEPARTMENT OF
ENVIRONMENTAL REGULATION
and other
STATE, LOCAL, AND FEDERAL AGENCIES

Tallahassee, Florida

1981

"If the world's total supply of water was poured upon the 50 United States, the land surfaces would be submerged to a depth of 90 miles.

"The conterminous United States receives a total volume of about 1,430 cubic miles of precipitation each year."

## CLIMATE

Much of the information on climate in this section is adapted from "Climate of Florida" and other records and reports of the National Oceanic and Atmospheric Administration, National Weather Service (formerly U.S. Weather Bureau).

Climatic conditions in Florida range from a zone of transition between temperate and subtropical in the extreme northern interior to tropical in the Florida Keys. The climate is affected by the southerly latitude (25° to 31°N), the Atlantic Ocean, the Gulf of Mexico, and by the many lakes located throughout the peninsula.

A temperate, or variable, zone (climate) is defined as being situated between the tropical and frigid zones, from latitude 23½°N to 66½°N. A tropical climate (defined by the National Oceanic and Atmospheric Administration, National Weather Service) is one in which the average temperature of the coldest month is 64.4° Fahrenheit (18.1° Celsius) or higher.

### Temperature

Florida summers are usually long with periods of very warm, humid air (50-95 percent relative humidity) throughout the State. Winters are generally mild except for short periods when cold fronts move southeastward from the northwestern section of the continent. Coastal areas are generally cooler in summer and slightly warmer in winter than inland areas at the same latitude.

Maximum temperatures in the State average about 90°F (32°C). Temperatures of 100°F (38°C) and higher are infrequent in most of the State and practically unknown in parts of southern Florida. June, July, and August are the hottest months on the average, exceeding 80°F throughout the State. The mean monthly maximum temperatures exceed 90°F for most of the State, except for much of the coastal areas.

Mean annual temperatures range from upper 60°F (16°C) in the northern part to middle 70°F (21°C) in the south, except for the Keys, which reach a mean annual temperature of nearly 78°F (26°C) (table 6). Overall, Florida is the hottest state and has the least seasonal range of temperature--about 30°F on the average. Some notable temperature extremes as of 1972 are: highest, 109°F at Monticello on June 29, 1931, and lowest, 2°F at Tallahassee on February 13, 1899.

No place in Florida is safe from frost or freezing, but it is rare for temperatures to remain below freezing throughout the day at any place in Florida. Very cold periods seldom last more than 2 or 3 days at a time.

Table 6.--Temperature data for selected long-term climatological stations in Florida listed alphabetically by counties

[Modified from National Oceanic and Atmospheric Administration, 1978a]

| County and station | Extreme temperature (°F)[1] | | | | Normal or average temperature (°F)[2] | | | | | | | | | | | | | Reference years of record and ending year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max | Date | Min | Date | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Year | | |
| Alachua, Gainesville 3 WSW | 102 | 1957 | 12 | 1962 | 57.2 | 58.6 | 63.6 | 70.0 | 75.8 | 80.0 | 81.1 | 81.2 | 79.1 | 71.8 | 63.3 | 57.8 | 69.9 | (25) | 1978 |
| Baker, Glen St. Mary 1 W | 103 | 1945 | 9 | 1962 | 54.2 | 56.3 | 61.3 | 68.0 | 73.9 | 78.9 | 80.6 | 80.6 | 77.8 | 69.6 | 60.6 | 54.7 | 68.0 | (83) | 1978 |
| Bay, Panama City 2 | 105 | 9/--/25 | 9 | 12/--/62 | 55.2 | 56.9 | 61.3 | 67.9 | 75.1 | 80.7 | 82.0 | 82.0 | 79.1 | 71.0 | 60.8 | 55.6 | 69.0 | (62) | 1960 |
| Bradford, Starke | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (21) | 1978 |
| Brevard, Melbourne | 102 | -- | 18 | -- | 61.8 | 62.7 | 66.5 | 71.5 | 75.6 | 79.4 | 81.2 | 81.5 | 80.3 | 75.1 | 67.9 | 63.1 | 72.2 | (41) | 1978 |
| Broward, Fort Lauderdale | 99 | 9/--/35 | 29 | 12/--/34 | 66.8 | 67.7 | 70.7 | 74.6 | 77.5 | 80.5 | 82.2 | 82.7 | 81.5 | 77.6 | 72.2 | 67.9 | 75.2 | (65) | 1978 |
| Calhoun, Blountstown | 105 | -- | 12 | -- | 51.4 | 54.1 | 59.8 | 67.9 | 74.6 | 79.9 | 81.1 | 81.1 | 77.7 | 68.6 | 58.3 | 52.1 | 67.2 | (66) | 1978 |
| Charlotte, Punta Gorda | 103 | 7/--/52 | 25 | 12/--/62 | 64.8 | 66.1 | 69.1 | 73.7 | 78.1 | 80.9 | 82.0 | 82.3 | 81.3 | 76.9 | 70.2 | 65.9 | 74.3 | (29) | 1960 |
| Citrus, Inverness | 105 | 1965 | 18 | 1905 | 59.8 | 61.8 | 65.3 | 70.6 | 76.4 | 80.5 | 81.6 | 81.9 | 80.1 | 73.3 | 65.0 | 60.2 | 71.4 | (61) | 1960 |
| Clay, Middleburg | 107 | -- | 12 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (28) | 1938 |
| Collier, Everglades | 99+ | 9/02/72 | 28 | 1/21/71 | 65.6 | 66.6 | 69.9 | 74.1 | 77.5 | 80.8 | 82.3 | 82.9 | 82.0 | 77.9 | 71.7 | 66.8 | 74.8 | (52) | 1978 |
| Columbia, Lake City 2 E | 105 | 6/10/54 | 10 | 12/13/62 | 54.6 | 56.7 | 62.0 | 68.9 | 75.0 | 79.5 | 80.8 | 80.9 | 78.0 | 70.2 | 61.4 | 55.8 | 68.7 | (95) | 1978 |
| Dade, Miami WSMO AP | 96 | 4/--/71 | 34 | 12/--/68 | 67.2 | 67.8 | 71.3 | 75.0 | 78.0 | 81.0 | 82.3 | 82.9 | 81.7 | 77.8 | 72.2 | 68.3 | 75.5 | (40) | 1978 |
| De Soto, Arcadia | 103 | 1927 | 18 | 1962 | 62.1 | 63.5 | 67.6 | 72.2 | 76.7 | 80.0 | 81.2 | 81.7 | 80.3 | 74.7 | 67.0 | 63.0 | 72.6 | (75) | 1978 |
| Dixie, Cross City 2 WNW | 103 | 7/--/50 | 17 | 2/--/43 | 54.4 | 56.2 | 61.6 | 68.5 | 74.7 | 79.5 | 80.8 | 79.8 | 78.9 | 70.6 | 61.1 | 55.2 | 68.6 | (19) | 1978 |
| Duval, Jacksonville WSO AP | 105 | 7/--/42 | 12 | 12/--/62 | 54.6 | 56.3 | 61.2 | 68.1 | 74.3 | 79.2 | 81.0 | 81.0 | 78.2 | 70.5 | 61.2 | 55.4 | 68.4 | (42) | 1978 |
| Escambia, Pensacola FAA AP | 100 | 7/--/72 | 11 | 1/--/66 | 52.1 | 54.8 | 59.9 | 68.1 | 75.2 | 80.6 | 81.8 | 81.8 | 78.3 | 70.0 | 59.5 | 53.8 | 68.0 | (34) | 1978 |
| Flagler, Marineland | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1978 |
| Franklin, Apalachicola WSO AP | 102 | 7/--/32 | 13 | 12/--/62 | 53.7 | 55.8 | 60.7 | 68.3 | 74.9 | 80.0 | 81.4 | 81.5 | 78.6 | 70.8 | 61.1 | 55.2 | 68.5 | (76) | 1978 |
| Gadsden, Quincy 3 SSW | 105 | -- | 12 | -- | 52.8 | 55.0 | 60.2 | 67.6 | 74.1 | 79.1 | 80.1 | 80.2 | 77.1 | 68.9 | 59.4 | 53.5 | 67.3 | (11) | 1978 |
| Gilchrist | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Glades, Moore Haven Lock 1 | 99 | 9/01/72 | 24 | 12/13/62 | 62.7 | 63.9 | 68.0 | 72.7 | 76.6 | 80.1 | 81.4 | 81.9 | 80.8 | 76.0 | 69.0 | 64.1 | 73.1 | (60) | 1978 |
| Gulf, Wewahitchka | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (23) | 1978 |
| Hamilton, Jasper 3 SE | 103 | -- | 5 | -- | 52.7 | 56.8 | 60.5 | 67.1 | 73.3 | 78.6 | 80.0 | 80.5 | 77.3 | 68.2 | 59.7 | 53.0 | 67.3 | ( 9) | 1960 |
| Hardee, Wauchula 2 N | -- | -- | -- | -- | 61.8 | 63.1 | 67.1 | 72.1 | 76.6 | 80.2 | 81.3 | 81.6 | 80.2 | 74.7 | 67.4 | 62.7 | 72.4 | (46) | 1978 |
| Hendry, La Belle | -- | -- | -- | -- | 63.4 | 64.7 | 68.5 | 73.1 | 76.9 | 80.4 | 81.5 | 81.9 | 80.6 | 75.6 | 68.5 | 64.3 | 73.3 | (48) | 1978 |
| Hernando, Brooksville Chin Hill | 100 | 5/28/62 | 15 | 12/13/62 | 60.2 | 61.6 | 66.1 | 71.7 | 76.6 | 80.2 | 80.8 | 81.0 | 79.6 | 73.7 | 66.0 | 61.3 | 71.6 | (86) | 1978 |
| Highlands, Avon Park 2 W | 103 | 7/31/61 | 20 | 12/13/62 | 62.9 | 64.2 | 68.4 | 73.5 | 77.9 | 81.3 | 82.4 | 82.3 | 81.3 | 75.8 | 68.8 | 64.1 | 73.6 | (86) | 1978 |
| Hillsborough, Tampa WSMO R | 98 | 8/--/75 | 23 | 1/--/71 | 60.4 | 61.8 | 66.0 | 72.0 | 77.2 | 81.0 | 81.9 | 82.2 | 80.8 | 74.7 | 66.8 | 61.6 | 72.2 | (89) | 1978 |
| Holmes, Bonifay | 107 | -- | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (26) | 1938 |
| Indian River, Fellsmere 7 SSW | 102 | 1958 | 21 | 1976 | 63.2 | 64.5 | 67.4 | 71.9 | 76.3 | 80.3 | 81.8 | 82.0 | 80.5 | 75.6 | 68.8 | 64.4 | 73.1 | -- | 1960 |
| Jackson, Marianna Sch for Boys | 106 | -- | 13 | -- | 54.4 | 56.3 | 61.1 | 67.7 | 74.7 | 80.0 | 81.0 | 80.8 | 77.6 | 69.0 | 59.2 | 54.4 | 68.0 | -- | 1960 |
| Jefferson, Monticello 3 W | 106 | 5/28/62 | 7 | 12/13/62 | 52.7 | 54.8 | 60.4 | 68.0 | 74.5 | 79.4 | 80.6 | 80.5 | 77.2 | 68.9 | 59.2 | 53.3 | 67.5 | (75) | 1978 |
| Lafayette, Mayo 5 NW | -- | -- | -- | -- | 55.3 | 58.0 | 61.6 | 68.1 | 75.2 | 80.2 | 81.4 | 81.3 | 78.4 | 70.3 | 60.0 | 54.7 | 68.7 | (11) | 1960 |
| Lake, Clermont 6 SSW | 101 | 7/31/61 | 19 | 12/13/62 | 60.0 | 61.7 | 66.3 | 72.2 | 77.3 | 80.9 | 81.7 | 82.2 | 80.5 | 74.3 | 66.3 | 60.9 | 72.0 | (86) | 1978 |
| Lee, Fort Myers WSO AP | 98 | 6/--/75 | 26 | 12/--/62 | 63.5 | 64.7 | 68.5 | 73.3 | 77.7 | 81.1 | 82.5 | 82.8 | 81.6 | 76.4 | 69.4 | 64.8 | 73.9 | (87) | 1978 |
| Leon, Tallahassee WSO AP | 100 | 8/--/72 | 10 | 12/--/62 | 52.8 | 54.8 | 60.3 | 67.9 | 74.8 | 80.0 | 81.1 | 81.1 | 78.1 | 69.3 | 58.9 | 53.2 | 67.7 | (92) | 1978 |
| Levy, Cedar Key 1 WSW | 103 | 1942 | 15 | 1962 | 58.3 | 60.0 | 64.0 | 70.5 | 77.4 | 81.9 | 82.5 | 82.7 | 81.1 | 74.5 | 65.6 | 59.8 | 71.5 | -- | 1960 |
| Liberty, Bristol | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1978 |
| Madison, Madison 4 N | 103 | 5/27/53 | 7 | 12/13/62 | 53.9 | 56.0 | 61.6 | 69.3 | 75.8 | 80.3 | 81.3 | 81.3 | 77.9 | 69.7 | 60.2 | 54.4 | 68.5 | (75) | 1978 |
| Manatee, Bradenton Exp Sta | 100 | 6/--/98 | 19 | 12/--/94 | 61.9 | 63.2 | 66.1 | 71.0 | 76.2 | 79.9 | 81.0 | 81.3 | 80.3 | 74.8 | 67.6 | 63.0 | 72.2 | (75) | 1960 |
| Marion, Ocala | 105 | 1933 | 16 | 1962 | 58.8 | 61.9 | 65.8 | 71.2 | 77.8 | 81.5 | 82.2 | 82.6 | 80.3 | 73.0 | 65.4 | 59.7 | 71.7 | (58) | 1960 |
| Martin, Stuart 1 N | 105 | 1942 | 26 | 1962 | 65.4 | 66.2 | 69.7 | 74.1 | 77.5 | 80.9 | 82.2 | 82.7 | 81.6 | 77.3 | 71.4 | 66.7 | 74.6 | (43) | 1978 |
| Monroe, Tavernier | 98+ | 9/03/63 | 38+ | 12/14/62 | 69.5 | 70.2 | 73.3 | 76.7 | 79.3 | 82.0 | 83.3 | 83.8 | 82.3 | 78.8 | 74.3 | 70.6 | 77.0 | (42) | 1978 |
| Nassau, Fernandina Beach | 102+ | 8/08/51 | 16 | 12/13/62 | 56.6 | 58.0 | 62.1 | 68.6 | 75.3 | 80. | 82.0 | 82.3 | 79.6 | 72.0 | 63.2 | 57.1 | 69.8 | (82) | 1978 |
| Okaloosa, Niceville | 103 | 1968 | 8 | 1962 | 50.4 | 52.7 | 58.0 | 66.1 | 73.0 | 78.9 | 80.7 | 80.7 | 77.0 | 68.1 | 57.8 | 51.7 | 65.3 | (52) | 1978 |
| Okeechobee, Okeechobee Hrcn Gate 6 | 99 | -- | 23 | -- | 62.9 | 64.7 | 67.8 | 72.5 | 77.2 | 79.8 | 80.7 | 81.4 | 80.3 | 76.0 | 70.0 | 63.8 | 73.1 | (13) | 1960 |
| Orange, Orlando WSO McCoy | 99 | 5/--/73 | 24 | 1/--/66 | 56.8 | 61.5 | 65.9 | 71.3 | 76.4 | 80.2 | 81.4 | 81.8 | 80.1 | 74.3 | 66.6 | 61.5 | 71.8 | ( 5) | 1978 |
| Osceola, Kissimmee 2 | 102 | 6/--/52 | 19 | 2/--/95 | 60.9 | 62.6 | 66.2 | 71.2 | 76.4 | 80.2 | 81.4 | 81.8 | 80.0 | 74.2 | 66.7 | 61.9 | 72.0 | -- | 1960 |
| Palm Beach, Belle Glade Exp Sta | 97+ | 6/13/52 | 25 | 1/18/65 | 62.8 | 63.7 | 67.3 | 71.3 | 75.1 | 78.8 | 80.3 | 80.7 | 79.7 | 75.1 | 68.6 | 64.0 | 72.3 | (54) | 1978 |
| Pasco, Saint Leo | 100+ | 5/28/62 | 18 | 12/13/62 | 60.5 | 62.0 | 66.5 | 72.2 | 77.3 | 80.8 | 81.7 | 82.0 | 80.4 | 74.2 | 66.6 | 61.7 | 72.2 | (84) | 1978 |
| Pinellas, Tarpon Spgs Sewage Pl | 98 | 7/02/57 | 19+ | 12/14/62 | 60.0 | 61.5 | 65.6 | 71.2 | 76.5 | 80.5 | 81.8 | 82.0 | 80.6 | 74.4 | 66.5 | 61.2 | 71.8 | (93) | 1978 |
| Polk, Lakeland 3 SE | 101 | 7/--/42 | 20 | 12/--/62 | 60.8 | 62.1 | 66.3 | 72.0 | 77.0 | 80.5 | 81.6 | 81.9 | 80.2 | 74.3 | 66.8 | 62.0 | 72.1 | (63) | 1978 |
| Putnam, Palatka | 105 | 1950 | 16 | 1962 | 59.2 | 61.0 | 65.0 | 70.6 | 76.8 | 81.2 | 82.5 | 82.5 | 80.3 | 73.2 | 64.8 | 59.4 | 71.4 | (53) | 1978 |
| St. Johns, St. Augustine | 102+ | 8/19/72 | 16 | 12/13/62 | 57.8 | 59.4 | 63.1 | 69.0 | 75.1 | 79.7 | 81.0 | 81.1 | 79.4 | 72.8 | 64.2 | 58.6 | 70.1 | (--) | 1960 |
| St. Lucie, Fort Pierce | 99 | 9/26/59 | 24 | 12/13/62 | 63.5 | 64.3 | 68.0 | 72.5 | 76.3 | 79.7 | 81.2 | 81.6 | 80.6 | 76.1 | 69.6 | 65.0 | 73.2 | (78) | 1978 |
| Santa Rosa, Milton Exp Sta | -- | -- | -- | -- | 54.0 | 55.9 | 59.1 | 66.3 | 74.1 | 78.9 | 80.5 | 80.7 | 76.6 | 67.8 | 57.6 | 53.1 | 67.1 | (12) | 1960 |
| Sarasota, Sarasota | -- | -- | -- | -- | 62.2 | 64.9 | 67.0 | 71.3 | 76.7 | 80.2 | 81.3 | 82.0 | 80.9 | 76.0 | 68.6 | 63.7 | 72.9 | (12) | 1960 |
| Seminole, Sanford Exp Sta | 102 | -- | 21 | -- | 60.2 | 61.4 | 65.8 | 71.3 | 76.4 | 80.4 | 81.8 | 81.9 | 80.0 | 74.2 | 66.5 | 61.5 | 69.0 | (23) | 1978 |
| Sumter, Bushnell 2 E | 100+ | 6/16/64 | 15 | 12/13/62 | 59.0 | 60.7 | 65.3 | 70.9 | 75.9 | 79.9 | 81.0 | 81.2 | 79.6 | 73.0 | 64.8 | 59.9 | 70.9 | (42) | 1978 |
| Suwannee, Live Oak | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (82) | 1978 |
| Taylor, Perry | 103 | -- | 15 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (56) | 1978 |
| Union, Raiford State Prison | 104 | -- | 6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1978 |
| Volusia, Daytona Bch WSO APR | 102 | 6/--/44 | 21 | 12/--/62 | 58.4 | 59.6 | 63.9 | 69.7 | 75.0 | 79.4 | 81.0 | 81.1 | 79.5 | 73.3 | 65.1 | 59.6 | 70.5 | (65) | 1978 |
| Wakulla, St. Marks 6 SE | 103 | 6/27/52 | 11 | 12/13/62 | 54.5 | 57.1 | 61.3 | 68.2 | 75.4 | 80.6 | 81.7 | 81.8 | 78.8 | 70.9 | 60.8 | 54.2 | 68.8 | (18) | 1960 |
| Walton, DeFuniak Springs | 105+ | 7/24/52 | 5 | 12/13/62 | 52.3 | 55.0 | 60.4 | 68.8 | 75.2 | 80.2 | 81.4 | 81.3 | 77.5 | 68.9 | 58.8 | 53.2 | 67.8 | (80) | 1978 |
| Washington, Chipley 3 E | 103 | 6/28/54 | 8 | 12/13/62 | 53.0 | 55.4 | 60.6 | 68.2 | 74.4 | 79.6 | 80.9 | 80.8 | 77.6 | 68.7 | 59.0 | 53.7 | 67.7 | (40) | 1978 |

[1] Extreme temperature.--Maximum and minimum figures for each county identified without dates are from U.S. Department of Agriculture, 1941, which may or may not be for same location as current station.

[2] Normal temperature.--Climatological normals are usually based on 30 years of record for periods 1931 through 1960, or 1941 through 1970, or earlier periods. Normals are not available for a few stations with 30 or more years of record through 1970 (as indicated by number of years of record through 1978).

Average temperature.--Long-term means (averages) are used in place of normals for varied periods of record of less than 30 years. Averages have been computed only through 1960 for some selected stations (as noted by ending year), even though stations may be currently in operation.

Table 8.--Rainfall data for selected long-term climatological stations in Florida listed alphabetically by counties

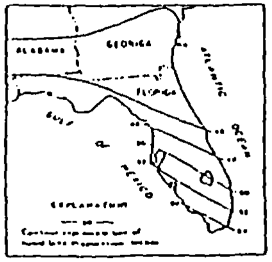
[Modified from National Oceanic and Atmospheric Administration, 1978a]

| County and station | Maximum rainfall (inches) | | | | Normal or average rainfall (inches)[1] | | | | | | | | | | | | | Reference years of record and ending year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | Date | Day | Date | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Year | | |
| Alachua, Gainesville 3 WSW | 20.19 | 6/92 | 9.93 | 10/--/41 | 2.84 | 3.70 | 4.26 | 3.02 | 3.54 | 6.81 | 8.03 | 8.25 | 5.67 | 3.67 | 1.92 | 2.88 | 54.59 | (25) | 1978 |
| Baker, Glen St. Mary 1 W | -- | -- | -- | -- | 3.17 | 4.04 | 4.37 | 2.94 | 4.13 | 6.60 | 8.82 | 7.97 | 7.14 | 3.79 | 2.31 | 3.47 | 58.75 | (83) | 1978 |
| Bay, Panama City 2 | -- | -- | 10.50 | 8/--/32 | 3.56 | 4.08 | 5.32 | 4.65 | 3.02 | 4.46 | 8.21 | 7.90 | 6.67 | 2.70 | 3.30 | 4.14 | 58.01 | (64) | 1960 |
| Bradford, Starke | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (21) | 1978 |
| Brevard, Melbourne | -- | -- | -- | -- | 2.20 | 2.81 | 3.68 | 2.36 | 3.57 | 6.54 | 6.05 | 5.63 | 8.19 | 5.55 | 2.60 | 1.61 | 50.79 | (41) | 1978 |
| Broward, Ft. Lauderdale | -- | -- | 10.85 | 10/--/47 | 2.27 | 2.30 | 2.46 | 3.44 | 5.51 | 8.17 | 5.92 | 6.91 | 8.61 | 8.93 | 2.93 | 2.63 | 60.08 | (65) | 1978 |
| *Calhoun, Blountstown* | -- | -- | -- | -- | *4.15* | *4.09* | *5.10* | *4.70* | *4.53* | 5.56 | 7.96 | 6.54 | 5.74 | 3.02 | 3.02 | 3.87 | 58.67 | (66) | 1978 |
| Charlotte, Punta Gorda 4 ESE | -- | -- | 9.00 | 9/--/62 | 1.91 | 2.30 | 2.79 | 2.37 | 3.64 | 9.12 | 7.39 | 7.20 | 8.02 | 4.06 | 1.34 | 1.65 | 51.79 | (14) | 1978 |
| Citrus, Inverness | -- | -- | -- | -- | 2.64 | 3.39 | 4.30 | 2.50 | 3.48 | 7.07 | 9.53 | 9.81 | 6.40 | 3.23 | 1.54 | 2.40 | 56.29 | (79) | 1978 |
| Clay, Camp Blanding | -- | -- | -- | -- | 2.16 | 2.38 | 3.37 | 3.30 | 3.05 | 5.78 | 7.90 | 6.87 | 6.38 | 4.99 | 1.79 | 2.50 | 50.47 | (16) | 1957 |
| Collier, Everglades | 23.47 | 6/69 | 10.09 | 6/30/66 | 1.67 | 1.79 | 1.96 | 2.43 | 4.66 | 9.49 | 8.60 | 6.79 | 9.60 | 4.76 | 1.42 | 1.23 | 54.40 | (52) | 1978 |
| Columbia, Lake City 2 E | 15.31 | 6/65 | 7.01 | 9/29/63 | 3.45 | 3.87 | 4.06 | 3.27 | 3.84 | 6.48 | 7.37 | 6.85 | 5.88 | 3.52 | 2.29 | 3.26 | 54.14 | (95) | 1978 |
| Dade, Miami WSMO AP | 24.40 | 9/60 | 9.95 | 10/--/48 | 2.15 | 1.95 | 2.07 | 3.60 | 6.12 | 9.00 | 6.91 | 6.72 | 8.74 | 8.18 | 2.72 | 1.64 | 59.80 | (40) | 1978 |
| De Soto, Arcadia | -- | -- | -- | -- | 2.16 | 2.55 | 2.95 | 2.51 | 4.10 | 9.07 | 8.84 | 7.79 | 7.57 | 4.07 | 1.84 | 1.98 | 55.43 | (78) | 1978 |
| Dixie, Cross City 2 WNW | 18.76 | 7/41 | 7.04 | 7/--/41 | 2.95 | 3.77 | 4.48 | 2.85 | 3.67 | 7.04 | 10.38 | 7.88 | 6.81 | 2.99 | 2.25 | 2.84 | 57.91 | (19) | 1978 |
| Duval, Jacksonville WSO AP | 19.36 | 9/49 | 10.17 | 9/--/50 | 2.78 | 3.58 | 3.56 | 3.07 | 3.22 | 6.27 | 7.35 | 7.89 | 7.83 | 4.54 | 1.79 | 2.59 | 54.47 | (42) | 1978 |
| Escambia, Pensacola FAA Ap | 16.03 | 7/75 | 10.02 | 9/--/67 | 4.37 | 4.69 | 6.31 | 4.99 | 4.25 | 6.30 | 7.33 | 6.67 | 8.15 | 3.13 | 3.37 | 4.66 | 64.22 | (34) | 1978 |
| Flagler, Marineland | -- | -- | -- | -- | 1.69 | 3.01 | 4.47 | 2.05 | 2.26 | 3.46 | 4.77 | 5.67 | 8.75 | 6.32 | 2.34 | 2.10 | 46.89 | ( 9) | 1960 |
| Franklin, Apalachicola WSO AP | 22.55 | 9/46 | 11.71 | 9/--/32 | 3.07 | 3.78 | 4.70 | 3.61 | 2.78 | 5.30 | 8.02 | 8.07 | 9.00 | 2.88 | 2.68 | 3.32 | 57.21 | (76) | 1978 |
| Gadsden, Quincy 3 SSW | -- | -- | -- | -- | 3.90 | 4.46 | 5.61 | 4.62 | 3.98 | 5.38 | 7.74 | 5.62 | 5.74 | 2.75 | 2.62 | 4.30 | 56.72 | (11) | 1978 |
| Gilchrist, | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Glades, Moore Haven Lock 1 | 18.56 | 7/74 | 6.00 | 6/12/55 | 1.76 | 2.06 | 2.88 | 2.67 | 4.43 | 8.05 | 7.16 | 6.57 | 7.49 | 4.48 | 1.14 | 1.53 | 50.22 | (60) | 1978 |
| Gulf, Wewahitchka | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | (23) | 1978 |
| Hamilton, Jasper 3 SE | -- | -- | -- | -- | 2.89 | 4.51 | 4.93 | 4.41 | 3.59 | 5.61 | 7.00 | 5.03 | 6.40 | 3.01 | 2.23 | 2.37 | 51.98 | (10) | 1960 |
| Hardee, Wauchula 2 N | -- | -- | -- | -- | 2.28 | 2.79 | 3.39 | 2.85 | 3.99 | 8.66 | 9.04 | 7.48 | 7.88 | 3.05 | 1.63 | 1.70 | 54.66 | (46) | 1978 |
| Hendry, La Belle | -- | -- | -- | -- | 1.76 | 2.23 | 3.25 | 2.54 | 4.52 | 9.65 | 8.52 | 7.70 | 7.49 | 4.20 | 1.25 | 1.51 | 54.62 | (48) | 1978 |
| Hernando, Brooksville Chin Hill | 17.70 | 3/60 | 8.58 | 7/29/60 | 2.69 | 3.37 | 4.44 | 2.70 | 3.50 | 7.65 | 9.02 | 9.60 | 7.29 | 3.09 | 1.76 | 2.53 | 57.64 | (86) | 1978 |
| Highlands, Avon Park 2 W | 18.95 | 6/54 | 6.32 | 11/25/53 | 2.14 | 2.77 | 3.36 | 3.08 | 3.93 | 9.13 | 8.75 | 7.25 | 7.72 | 3.87 | 1.64 | 1.70 | 55.34 | (81) | 1978 |
| Hillsborough, Tampa WSMO R | 20.59 | 7/60 | 12.11 | 7/--/60 | 2.33 | 2.86 | 3.89 | 2.10 | 2.41 | 6.49 | 8.43 | 8.00 | 6.35 | 2.54 | 1.79 | 2.19 | 49.38 | (89) | 1978 |
| Holmes, Bonifay | -- | -- | -- | -- | 4.82 | 4.91 | 4.20 | 4.92 | 3.76 | 5.05 | 7.69 | 5.14 | 4.72 | 2.96 | 3.33 | 4.65 | 56.15 | (25) | 1931 |
| Indian River, Fellsmere 7 SSW | -- | -- | -- | -- | 2.08 | 2.29 | 3.54 | 2.63 | 3.86 | 7.41 | 6.79 | 7.99 | 8.66 | 6.85 | 2.07 | 1.71 | 55.88 | (66) | 1978 |
| Jackson, Marianna Ind School | -- | -- | -- | -- | 3.78 | 4.34 | 5.70 | 5.02 | 4.30 | 4.82 | 7.67 | 6.47 | 4.81 | 2.08 | 3.27 | 4.07 | 56.33 | (70) | 1960 |
| Jefferson, Monticello 3 W | 23.35 | 9/57 | 7.41 | 9/16/57 | 3.76 | 4.26 | 5.60 | 4.23 | 3.62 | 5.89 | 7.42 | 5.32 | 5.63 | 2.70 | 2.42 | 3.71 | 54.56 | (75) | 1978 |
| Lafayette, May 5 NW | -- | -- | -- | -- | 2.39 | 3.51 | 4.62 | 4.69 | 3.92 | 6.36 | 8.33 | 6.11 | 6.43 | 4.30 | 2.42 | 2.34 | 55.42 | (11) | 1960 |
| Lake, Clermont 6 SSW | 16.23 | 8/67 | 5.62 | 10/16/56 | 2.34 | 2.93 | 3.89 | 2.95 | 2.91 | 7.00 | 8.62 | 7.24 | 6.56 | 3.16 | 1.66 | 2.14 | 51.40 | (86) | 1978 |
| Lee, Fort Myers WSO AP | 20.10 | 6/74 | 10.85 | 10/--/51 | 1.64 | 2.03 | 3.06 | 2.03 | 3.99 | 8.89 | 8.90 | 7.72 | 8.71 | 4.37 | 1.31 | 1.30 | 53.95 | (87) | 1978 |
| Leon, Tallahassee WSO AP | 20.12 | 7/64 | 9.47 | 9/--/69 | 3.74 | 4.77 | 5.93 | 4.07 | 4.04 | 6.62 | 8.92 | 6.89 | 6.64 | 2.93 | 2.81 | 4.22 | 61.58 | (94) | 1978 |
| Levy, Cedar Key | -- | -- | -- | -- | 2.47 | 2.81 | 3.62 | 2.95 | 2.02 | 4.19 | 8.08 | 7.40 | 6.38 | 3.07 | 1.38 | 2.19 | 46.56 | (82) | 1960 |
| Liberty, Bristol | -- | -- | -- | -- | 2.77 | 4.18 | 4.62 | 5.48 | 5.01 | 5.82 | 5.94 | 4.80 | 5.46 | 3.72 | 2.84 | 3.46 | 54.10 | (10) | 1960 |
| Madison, Madison 4 N | 20.44 | 9/57 | 8.90 | 3/31/62 | 3.43 | 3.94 | 5.36 | 3.88 | 3.34 | 5.61 | 7.19 | 6.03 | 5.48 | 2.61 | 2.39 | [illegible] | 52.63 | (78) | 1978 |
| Manatee, Bradenton 5 ESE | 25.62 | 6/12 | 10.80 | 6/--/45 | 2.68 | 2.87 | 3.65 | 2.43 | 2.60 | 7.63 | 8.94 | 9.55 | 8.68 | 3.24 | 1.91 | [illegible] | 56.35 | (14) | 1978 |
| Marion, Ocala | 16.26 | 9/50 | 8.00 | 9/--/50 | 2.38 | 3.01 | 3.55 | 3.04 | 3.98 | 7.30 | 8.40 | 7.82 | 6.77 | 3.27 | 1.75 | [illegible] | 53.95 | (65) | 1960 |
| Martin, Stuart 1 N | -- | -- | 6.50 | 4/--/37 | 2.43 | 2.52 | 3.46 | 2.83 | 4.48 | 7.16 | 6.55 | 6.19 | 8.46 | 7.48 | 2.17 | 2.26 | 55.99 | (43) | 1978 |
| Monroe, Tavernier | 21.83 | 6/67 | 8.51 | 10/30/62 | 2.00 | 1.92 | 1.87 | 2.28 | 4.37 | 6.61 | 4.75 | 4.88 | 7.45 | 8.35 | 2.36 | 2.05 | 48.89 | (42) | 1978 |
| Nassau, Fernandina Beach | 23.80 | 11/69 | 22.02 | 11/01/69 | 2.65 | 3.35 | 3.82 | 2.68 | [illegible] | 5.27 | 6.65 | 6.99 | 8.09 | 4.71 | 2.59 | 2.67 | 52.88 | (82) | 1978 |
| Okaloosa, Niceville | -- | -- | -- | -- | 4.35 | 4.47 | [illegible] | 4.91 | [illegible] | 6.18 | 8.35 | 7.52 | 7.48 | 3.17 | 3.48 | 4.90 | 64.14 | (52) | 1978 |
| Okeechobee, Okeechobee Hrcn Gate 6 | -- | -- | -- | -- | 1.80 | 2.10 | [illegible] | 2.71 | [illegible] | 7.61 | 5.89 | 6.26 | 6.84 | 4.88 | [illegible] | 1.47 | 47.44 | (56) | 1978 |
| Orange, Orlando WSO McCoy | 19.57 | 7/60 | 9.67 | 9/--/45 | 2.28 | 2.95 | [illegible] | 2.72 | 2.94 | 7.11 | [illegible] | 6.73 | 7.20 | 4.07 | [illegible] | 1.90 | 51.21 | ( 5) | 1978 |
| Osceola, Kissimmee 2 | 17.13 | 6/45 | 9.50 | 10/--/99 | 1.91 | 2.44 | 4.03 | 3.34 | [illegible] | 7.75 | [illegible] | 6.83 | 7.25 | 3.97 | [illegible] | 1.90 | 52.80 | (70) | 1960 |
| Palm Beach, Belle Glade Exp Sta | 19.50 | 9/60 | 6.29 | 10/02/51 | 1.99 | 1.97 | 3.21 | 2.96 | [illegible] | 9.08 | 8.58 | 8.21 | 8.82 | 3.65 | 1.74 | 1.80 | 58.75 | (54) | 1978 |
| Pasco, Saint Leo | 19.08 | 6/74 | 9.17 | 4/13/53 | 2.55 | 3.13 | 4.53 | 3.10 | 3.79 | 8.02 | 8.68 | 8.55 | 7.08 | 2.93 | 1.87 | 2.36 | 56.59 | (86) | 1978 |
| Pinellas, Tarpon Spgs Sewage Pl | 20.76 | 7/60 | 8.70 | 7/29/60 | 2.69 | 2.82 | 4.36 | 2.68 | 2.52 | 5.58 | 9.10 | 9.32 | 7.37 | 2.78 | 1.91 | [illegible] | 53.67 | (88) | 1978 |
| Polk, Lakeland 3 SE | 15.67 | 7/60 | 10.12 | 6/--/45 | 2.32 | 2.52 | 4.02 | 2.57 | 3.44 | 6.70 | 8.09 | 7.18 | 6.06 | 2.84 | 1.60 | [illegible] | 49.43 | (63) | 1978 |
| Putnam, Palatka | -- | -- | 8.56 | 10/--/51 | 2.54 | 3.42 | 4.05 | 3.00 | 3.32 | 6.49 | 7.74 | 7.56 | 7.58 | 4.88 | 1.85 | [illegible] | 54.84 | (53) | 1978 |
| St. Johns, St. Augustine | 21.80 | 9/63 | 9.52 | 9/18/63 | 2.35 | 3.06 | 4.05 | 3.25 | 2.85 | 5.35 | 6.21 | 5.88 | 7.77 | 6.56 | 2.48 | 2.57 | 52.38 | (92) | 1960 |
| St. Lucie, Fort Pierce | 19.90 | 9/63 | 6.62 | 9/24/63 | 2.10 | 2.77 | 3.50 | 3.33 | 4.15 | 6.11 | 5.53 | 6.35 | 8.69 | 7.87 | 2.36 | 2.24 | 54.91 | (78) | 1978 |
| Santa Rosa, Milton Exp Sta | -- | -- | -- | -- | 3.85 | 4.16 | 5.81 | 6.43 | 3.81 | 6.99 | 8.52 | 4.91 | 8.40 | 3.02 | 3.57 | 5.30 | 64.77 | (12) | 1960 |
| Sarasota, Sarasota | -- | -- | -- | -- | 2.24 | 2.65 | 3.53 | 3.57 | 2.84 | 5.11 | 8.03 | 8.60 | 9.96 | 3.92 | 2.17 | 2.51 | 55.13 | (13) | 1960 |
| Seminole, Sanford Exp Sta | -- | -- | -- | -- | 2.31 | 2.84 | 3.90 | 2.69 | 2.83 | 7.19 | 8.35 | 6.99 | 7.76 | 4.56 | 1.75 | 2.15 | 53.32 | (23) | 1978 |
| Sumter, Bushnell 2 E | 16.85 | 6/74 | 6.90 | 6/25/74 | 2.46 | 3.22 | 4.34 | 3.12 | 3.64 | 6.97 | 8.97 | 7.43 | 6.65 | 3.25 | 1.51 | 2.18 | 53.74 | (42) | 1978 |
| Suwannee, Live Oak 2 ESE | -- | -- | -- | -- | 3.01 | 3.38 | 4.64 | 4.62 | 3.60 | 7.11 | 9.17 | 4.81 | 5.81 | 3.30 | 1.89 | 2.15 | 53.49 | ( 8) | 1960 |
| Taylor, Perry[2] | -- | -- | -- | -- | 2.85 | 3.56 | 4.20 | 2.86 | 3.74 | 6.46 | 9.55 | 7.43 | 6.66 | 2.46 | 3.65 | 2.20 | 55.32 | ( 9) | 1938 |
| Union, Raiford St Prison | -- | -- | -- | -- | 2.68 | 3.40 | 3.39 | 3.06 | 3.84 | 6.38 | 7.64 | 6.82 | 5.39 | 3.41 | 1.63 | 3.21 | 50.85 | (58) | 1956 |
| Volusia, Daytona Bch WSO APR | 19.89 | 8/53 | 9.29 | 10/--/53 | 2.05 | 2.92 | 3.37 | 2.39 | 2.65 | 6.60 | 6.69 | 6.84 | 7.10 | 5.52 | 2.13 | 1.96 | 50.22 | (65) | 1978 |
| Wakulla, St. Marks 5 SSE | 28.55 | 9/57 | 8.36 | 4/28/64 | 3.57 | 4.03 | 4.86 | 3.78 | 3.33 | 6.15 | 7.87 | 6.22 | 6.41 | 2.87 | 2.58 | 3.45 | 55.12 | (51) | 1978 |
| Walton, DeFuniak Springs | 16.14 | 12/53 | 7.01 | 10/30/67 | 4.70 | 4.72 | 6.81 | 5.01 | 4.37 | 6.36 | 8.82 | 7.66 | 6.78 | 3.21 | 3.52 | 4.97 | 66.92 | (80) | 1978 |
| Washington, Chipley 3 E | 16.43 | 12/53 | 7.35 | 4/02/60 | 4.22 | 4.32 | 5.94 | 4.59 | 3.97 | 5.07 | 6.51 | 5.75 | 5.14 | 2.68 | 3.12 | 4.52 | 55.83 | (40) | 1978 |

[1] Normal rainfall.--Climatological normals are usually based on 30 years of record for periods 1931 through 1960, or 1941 through 1970, or earlier period. Normals are not available for a few stations with 30 or more years of record through 1970 (as indicated by number of years of record through 1978).

Average rainfall.--Long-term means (averages) are used in place of normals for varied periods of record of less than 30 years. Averages have been computed only through 1960 for some selected stations (as noted by ending year), even though stations may be currently in operation.

[2] U.S. Department of Agriculture, 1941.

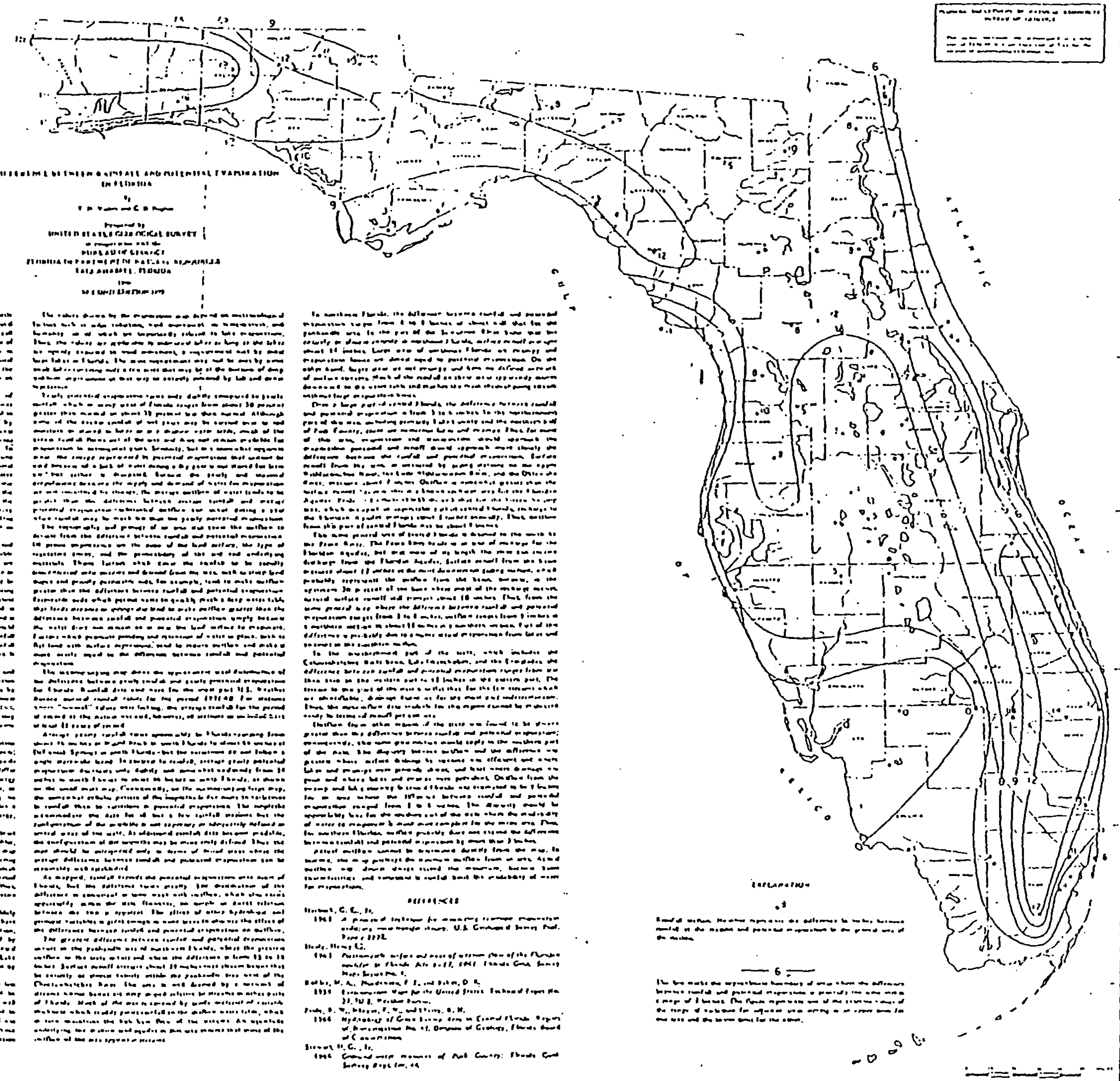



AVERAGE ANNUAL LAKE EVAPORATION

# THE DIFFERENCE BETWEEN RAINFALL AND POTENTIAL EVAPORATION IN FLORIDA

Prepared by
UNITED STATES GEOLOGICAL SURVEY

TALLAHASSEE, FLORIDA

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U.S. DEPARTMENT OF COMMERCE
Luther H. Hodges, Secretary

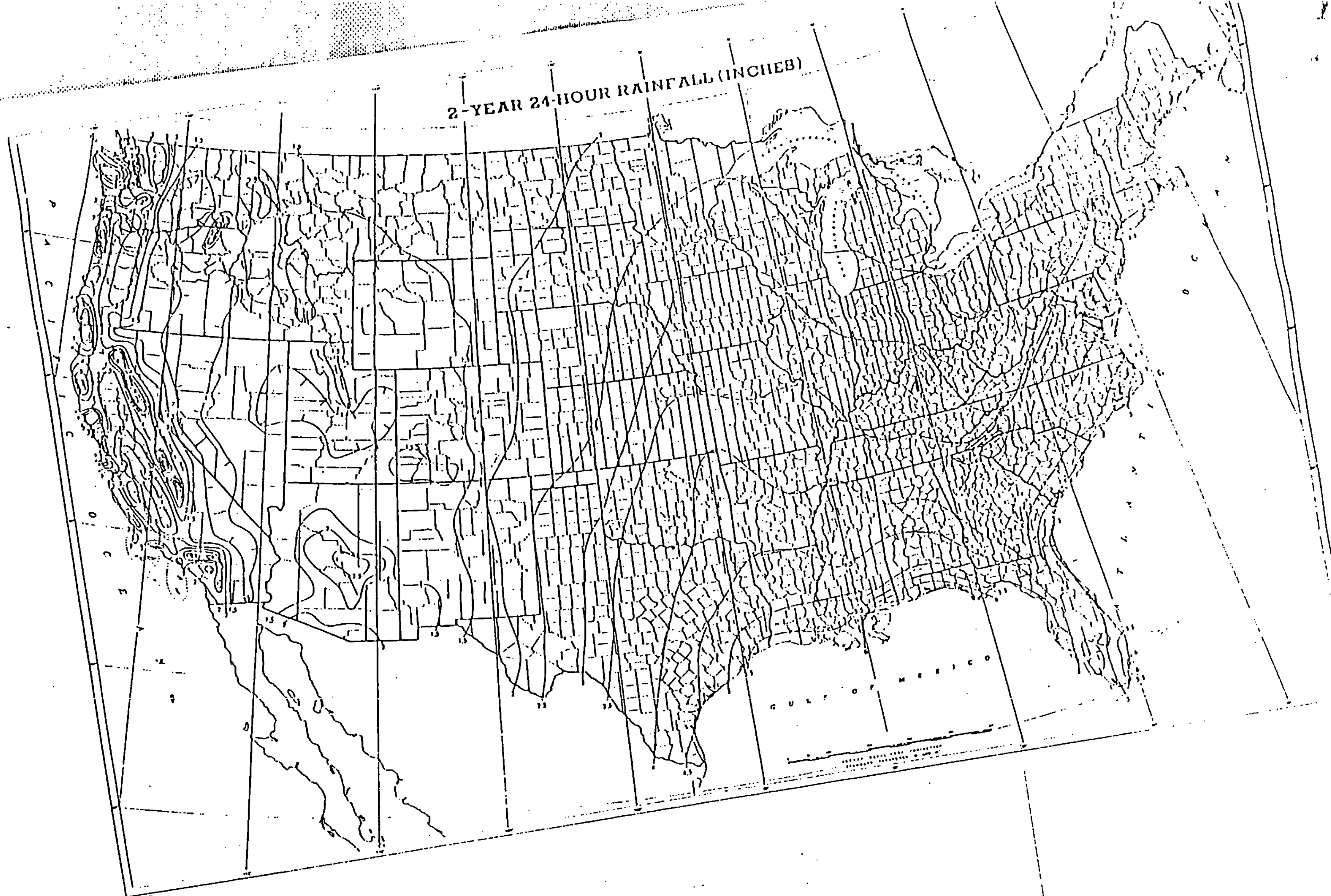
WEATHER BUREAU
F. W. Reichelderfer, Chief

## TECHNICAL PAPER NO. 40

# RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

## for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years

Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture


2-YEAR 24-HOUR RAINFALL (INCHES)
GULF OF MEXICO

U.S. Fish and Wildlife Service
Ecological Services
75 Spring Street, SW., Room 1276
Atlanta, Georgia 30303
Telephone: 404/331-3580

February 3, 1994

TO: Mr. Jim McCarthy, DER

RE: Information Request

Thank you for your interest in endangered species amd critical habitat areas. Enclosed are a national list of federally-listed species and critical habitat designations within the Southeast.

The critical habitat designations are from the Red Book, published in January 1992. The Literature Citation would be:

U.S. Fish and Wildlife Service. 1992. Endangered and Threatened Species of the Southeast United States (The Red Book). Prepared by Ecological Services, Division of Endangered Species, Southeast Region. Government Printing Office, Washington, DC. 1,070 pp.

We hope these materials are helpful.

Sincerely yours,

Elsie Davis

Elsie Davis
Editorial Assistant

Enclosures (3)

4/91 Bureau of Waste Cleanup

FEB 8 1993

Technical Review Section

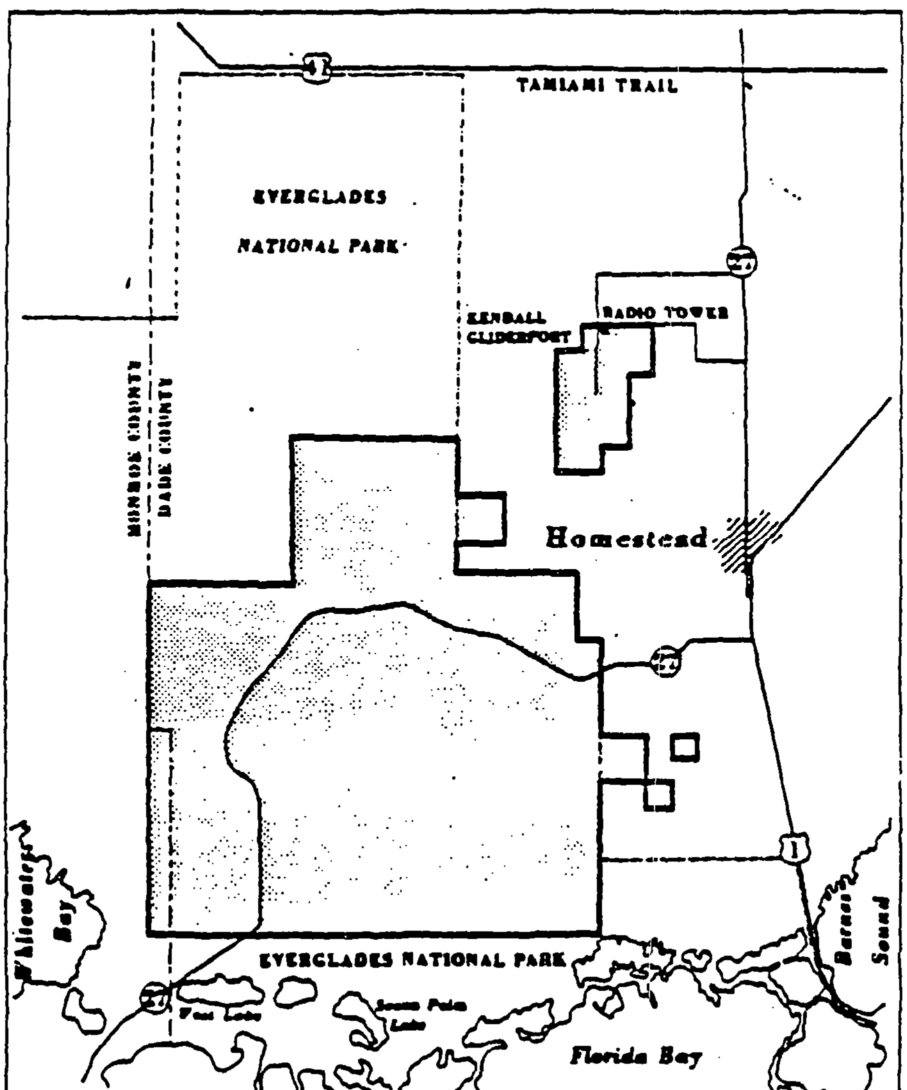
# CRITICAL HABITAT INDEX

| | |
|---|---|
| **Alabama:** | Etheostoma boschungi (slackwater darter) |
| | Peromyscus polionotus ammobates (Alabama beach mouse) |
| | Peromyscus polionotus trissyllepsis (Perdido Key beach mouse) |
| | Speoplatyrhinus poulsoni (Alabama cavefish) |
| **Arkansas:** | Percina pantherina (leopard darter) |
| **Florida:** | Ammospiza maritima mirabilis (Cape Sable sparrow) |
| | Crocodylus acutus (American crocodile) |
| | Peromyscus polionotus allophrys (Choctawhatchee beach mouse) |
| | Peromyscus polionotus trissyllepsis (Perdido Key beach mouse) |
| | Rostrhamus sociabilis plumbeus (Everglade kite) |
| | Trichechus manatus (Florida manatee) |
| **Georgia:** | Percina antesella (amber darter) |
| | Percina jenkinsi (Conasauga logperch) |
| **Kentucky:** | Myotis sodalis (Indiana bat) |
| | Palaemonias ganteri (Kentucky cave shrimp) |
| **Louisiana:** | No designations |
| **Mississippi:** | Grus canadensis pulla (Mississippi sandhill crane) |
| **North Carolina:** | Hudsonia montana (mountain golden heather) |
| | Hybopsis monacha (spotfin chub) |
| | Menidia extensa (waccamaw silverside) |
| | Notropis mekistocholas (Cape Fear shiner) |

FLORIDA - Critical Habitat

*Ammospiza maritima mirabilis*, "Cape Sable sparrow"

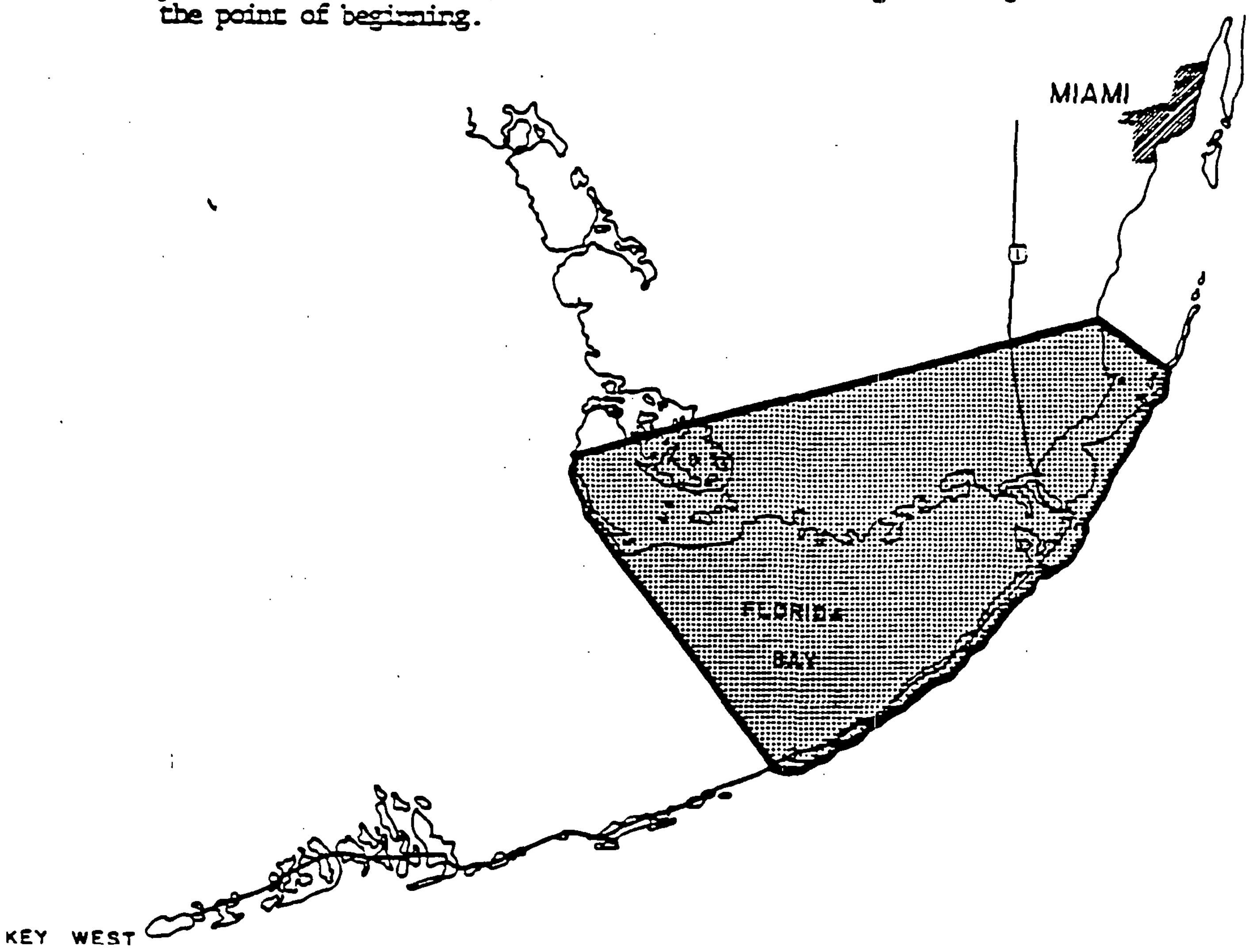
Florida. Areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Dade, and Monroe counties, with the following components (Tallahassee Meridian): Those portions of Everglades National Park within T57S R36E, T57S R36½E, T57S R37E, T58S R35E, T58S R36E, T58S R37E, T58½S R35E, T58½S R36½E, T59S R35E, T59S R36E, T59S R37E. Areas outside of Everglades National Park within T55S R37E Sec. 36; T55S R38E Sec. 31, 32; T56S R37E Sec. 1, 2, 11-14, 23-26; T56S R38E Sec. 5-7, 18, 19; T57S R37E Sec. 5-8, T58S R38E Sec. 27, 29-32; T59S R38E Sec. 4.



FLORIDA - Critical Habitat

Crocodylus acutus, "American crocodile"

The following area (exclusive of those existing man-made structures or settlements which are not necessary to the normal needs or survival of the species) is critical habitat for the American crocodile (*Crocodylus acutus*): All land and water within the following boundary in Florida: beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; thence southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; thence southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Anglefish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key, to the westernmost tip of Long Key; thence northwestward along a straight line to the westernmost tip of Middle Cape; thence northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; thence eastward along a straight line to the northernmost point of Nine-Mile Pond; thence northeastward along a straight line to the point of beginning.

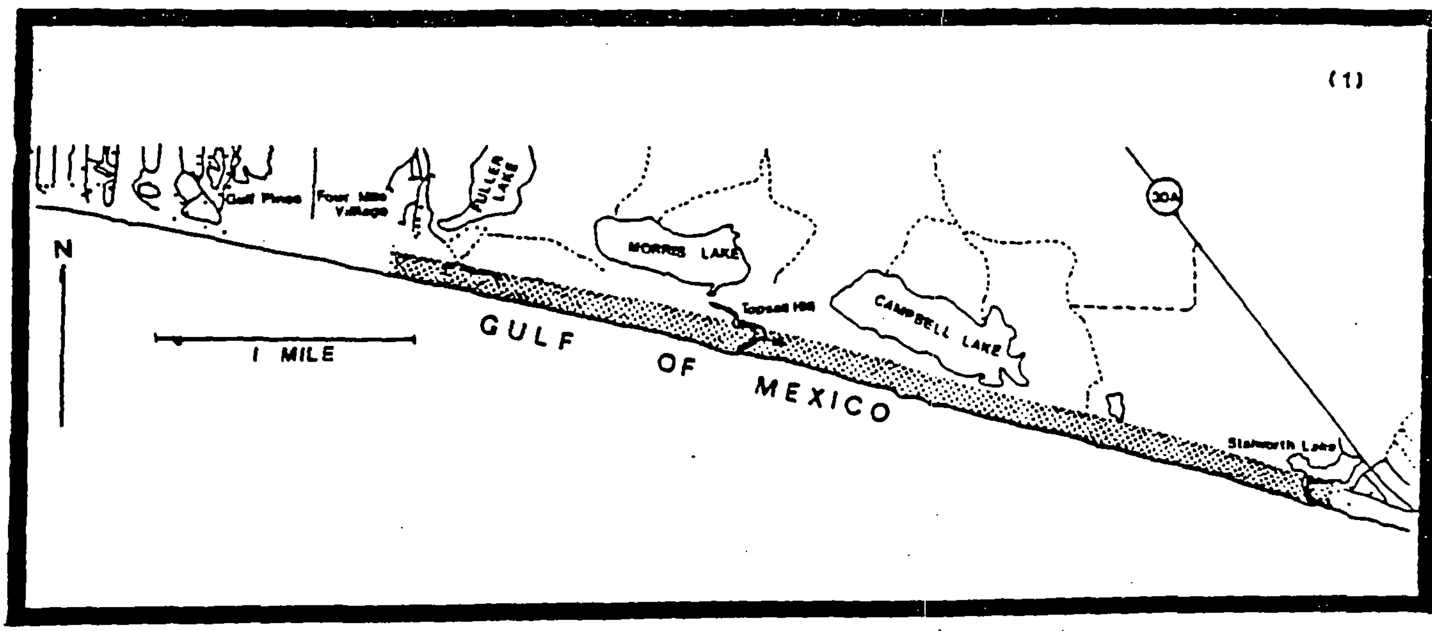


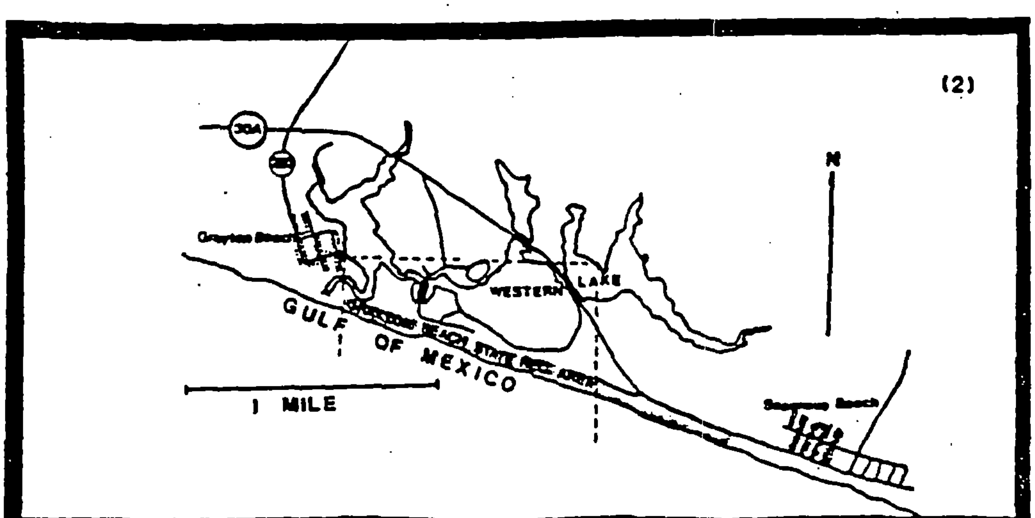
FLORIDA - Critical Habitat

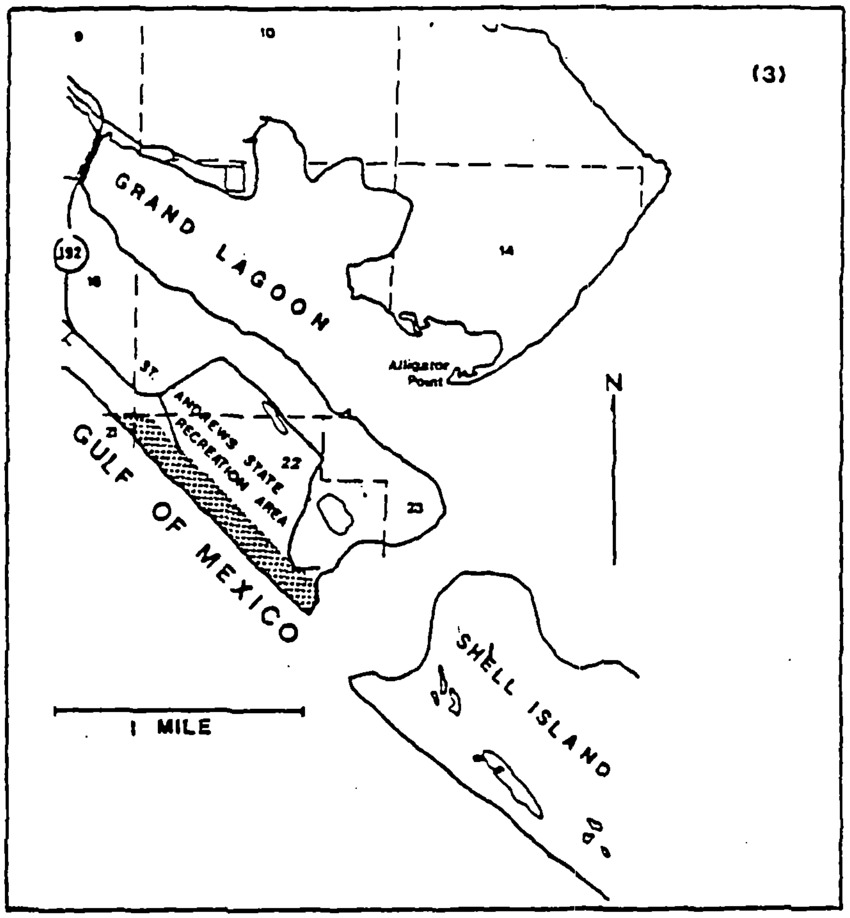
Peromyscus polionotus allophrys, "Choctawhatchee beach mouse"

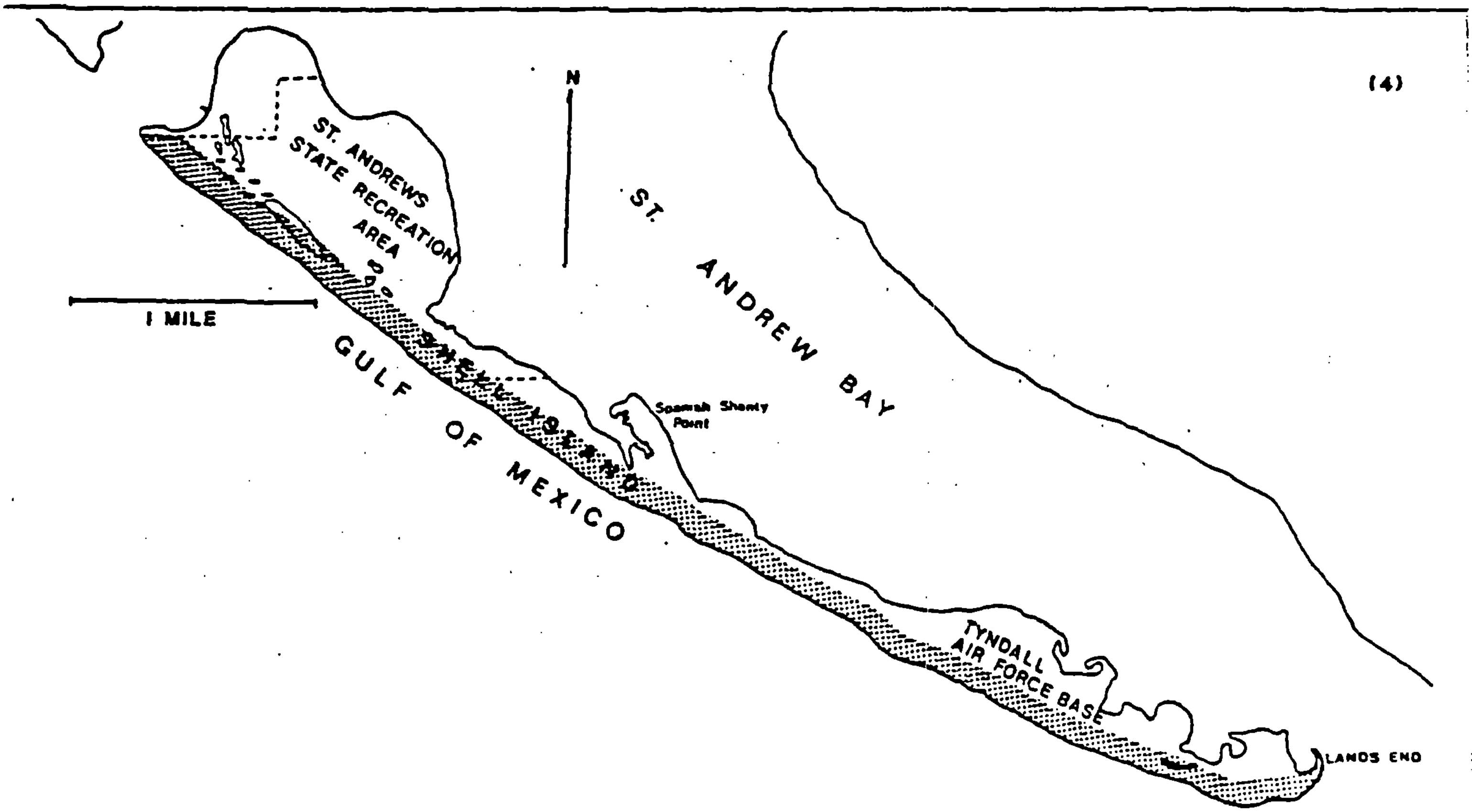
Areas of land, water, and airspace in Walton and Bay Counties with the following components (Tallahassee Meridian): (1) those portions of T2S R21W E 5/8 Sec. 35, Sec. 36, T2S R20W S 1/4 Sec. 31, and T3S R20W W 1/8 Sec. 4, N 1/2 Sec. 5, and NE 1/4 Sec. 6 extending 152.5 meters (500 feet) inland from the mean high tide line of the Gulf of Mexico; (2) those portions of T3S R19W W 1/2 Sec. 15 and Sec. 16 extending 152.5 meters (500 feet) inland from the mean high tide line of the Gulf of Mexico; (3) those portions of the mainland part of the St. Andrews State Recreation Area in T4S R15W Sec. 21 and Sec. 22 extending 152.5 meters (500 feet) inland from the mean high tide line of the Gulf of Mexico; (4) those portions of Shell Island in T4S R15W Sec. 25-27 and Sec. 36, T4S R14W Sec. 31, and T5S R14W Sec. 4-6 extending 152.5 meters (500 feet) inland from the mean high tide line of the Gulf of Mexico.

Within these areas the major constituent elements that are known to require special management considerations or protection are dunes and interdunal areas, and associated grasses and shrubs that provide food and cover.




(3)
9
10
GRAND LAGOON
392
16
14
Alligator Point
N
ST. ANDREWS STATE RECREATION AREA
21
22
23
GULF OF MEXICO
SHELL ISLAND
1 MILE

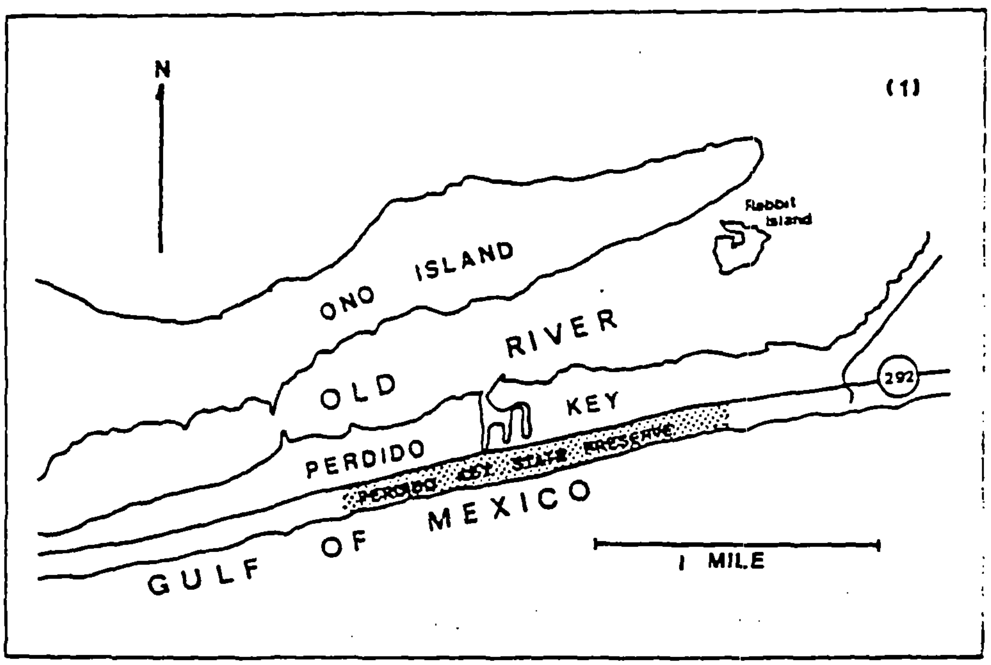

(4)
N
ST. ANDREWS STATE RECREATION AREA
ST. ANDREW BAY
1 MILE
GULF OF MEXICO
SHELL ISLAND
Spanish Shanty Point
TYNDALL AIR FORCE BASE
LANDS END

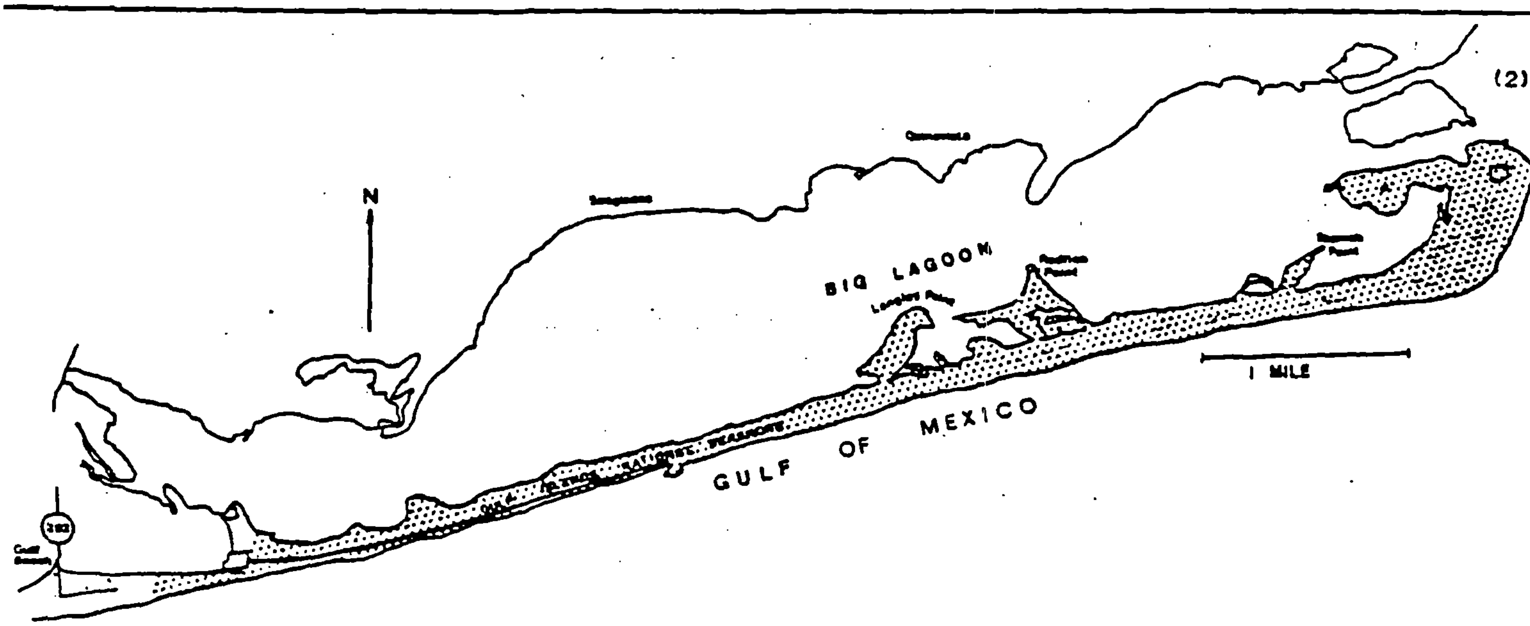
FLORIDA - Critical Habitat

<u>Peromyscus polionotus trissyllepsis</u>, "Perdido Key beach mouse"

Areas of land, water, and airspace in Escambia County with the following components (Tallahassee Meridian): (1) that portion of the Perdido Key State Preserve south of State Road 292 in T3S R32W Sec. 32-33 and T4S R32W Sec. 5; (2) those portions of Perdido Key in T3S R31W Sec. 25-26 and Sec. 28-34, and in T3S R32W E 1/2 Sec. 36, and W 1/2 Sec. 36 south of the entrance road, parking lot, and Johnson Beach recreational facilities at the Gulf Islands National Seashore.

Within these areas the major constituent elements that are known to require special management considerations or protection are dunes and interdunal areas, and associated grasses and shrubs that provide food and cover.



FLORIDA - Critical Habitat

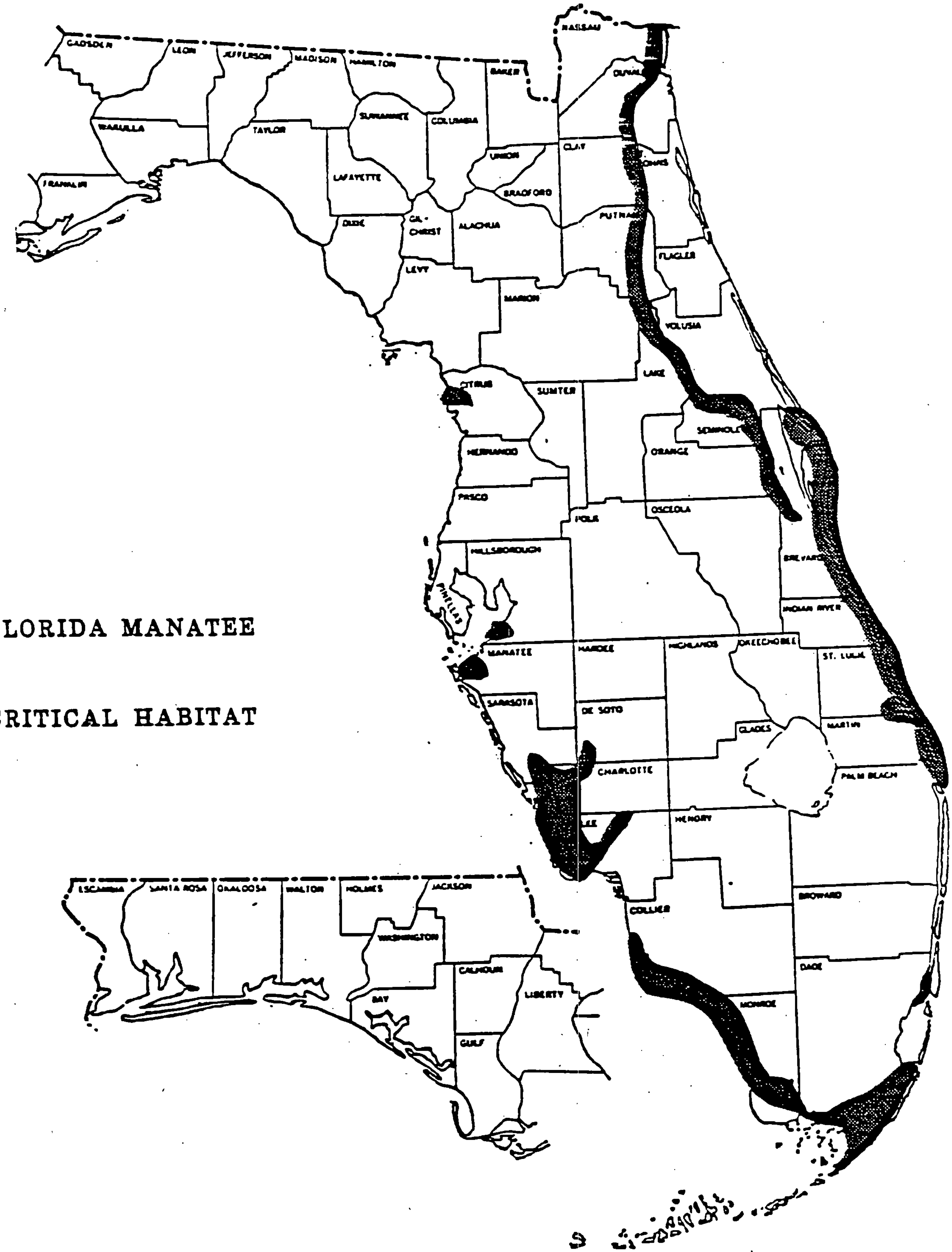
Trichechus manatus, "Florida manatee"

The following areas (exclusive of those existing man-made structures or settlements which are not necessary to the normal needs or survival of the species) in Florida are critical habitat for the Florida manatee *(Trichechus manatus)*: Crystal River and its headwaters known as King's Bay, Citrus County; the Little Manatee River downstream from the U. S. Highway 301 bridge, Hillsborough County; the Manatee River downstream from the Lake Manatee Dam, Manatee County; the Myakka River downstream from Myakka River State Park, Sarasota and Charlotte Counties; the Peace River downstream from the Florida State Highway 760 bridge, De Soto and Charlotte Counties; Charlotte Harbor north of the Charlotte-Lee county line, Charlotte County; Caloosahatchee River downstream from the Florida State Highway 31 bridge, Lee County; all U. S. territorial waters adjoining the coast and islands of Lee County; all U. S. territorial waters adjoining the coast and islands and all connected bays, estuaries, and rivers from Gordon's Pass, near Naples, Collier County, southward to and including Whitewater Bay, Monroe County; all waters of Card, Barnes; Blackwater, Little Blackwater, Manatee, and Buttonwood sounds between Key Largo, Monroe County, and the mainland of Dade County; Biscayne Bay, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Dade County; all of Lake Worth, from its northernmost point immediately south of the intersection of U. S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of the town of Boynton Beach, Palm Beach County; the Loxahatchee River and its headwaters, Martin and West Palm Beach Counties; that section of the intracoastal waterway from the town of Sewalls Point, Martin County to Jupiter Inlet, Palm Beach County; the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U. S. Highway 1 and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Sewalls Point, Martin County, and the entire inland section of water known as the Banana River and all waterways between the Indian and Banana Rivers, Brevard County; the St. Johns River, including Lake George, and including Blue Springs and Silver Glen Springs from their points of origin to their confluences with the St. Johns River; that section of the Intra-coastal Waterway from its confluence with the St. Marys River on the Georgia-Florida border to the Florida State Highway A1A bridge south of Coastal City, Nassau and Duval Counties.

(over)

FLORIDA MANATEE

CRITICAL HABITAT



FLORIDA - Critical Habitat

Rostrhamus sociabilis plumbeus, "everglade kite"

Florida. Areas of land (predominantly marsh), water, and airspace, with the following components (Tallahassee Meridian): (1) St. Johns Reservoir, Indian River County: T33S R37E SW¼ Sec. 6, W½ Sec. 7, Sec. 18, Sec. 19; (2) Cloud Lake Reservoir, St. Lucie County: T34S R38E S½ Sec. 16, N½ Sec. 21; (3) Strazzulla Reservoir. St. Lucie County: T34S R38E SW ¼ Sec. 21; (4) western parts of Lake Okeechobee, Glades and Hendry Counties, extending along the western shore to the east of the levee system and the undiked high ground at Fisheating Creek, and from the Hurricane Gate at Clewiston northward to the mouth of the Kissimmee River, including all the Eleocharis flats of Moonshine Bay, Monkey Box, and Observation Shoal, but excluding the open water north and west of the northern tip of Observation Shoal, north of Monkey Box, and east of Fisheating Bay; (5) Loxahatchee National Wildlife Refuge (Central and Southern Florida Flood Control District Water Conservation Area 1), Palm Beach County, including Refuge Management Compartments A, B, C, and D, and all of the main portion of the Refuge as bounded by Levees L-7, L-39, and L-40; (6) Central and Southern Florida Flood Control District Water Conservation Area 2A, Palm Beach and Broward Counties, as bounded by Levees L-6, L-35B, L-36, L-38, and L-39; (7) Central and Southern Florida Flood Control District Water Conservation Area 2B, Broward County, as bounded by Levees L-35, L-35B, L-36, and L-38; (8) Central and Southern Florida Flood Control District Water Conservation Area 3A, Broward and Dade Counties, as bounded by Florida Highway 84, Levees L-68A, L-67A (north of Miami Canal), L-67C (south of Miami Canal), L-29, and L-28, and a line along the undiked northwestern portion of the Area; (9) that portion of Everglades National Park, Dade County, within the following boundary: beginning at the point where the Park boundary meets Florida Highway 94 in T54S R35E Sec. 20, thence eastward and southwest along the Park boundary to the southwest corner of Sec. 31 in T57S R37E, thence southwestward along a straight line to the southwest corner of Sec. 2 in T58S R35E, thence westward along the south sides of Sec. 3, 4, 5, and 6 in T58S R35E to the Dade-Monroe county line, thence northward along the Dade-Monroe county line to the Park boundary, thence eastward and northward along the Park boundary to the point of beginning.

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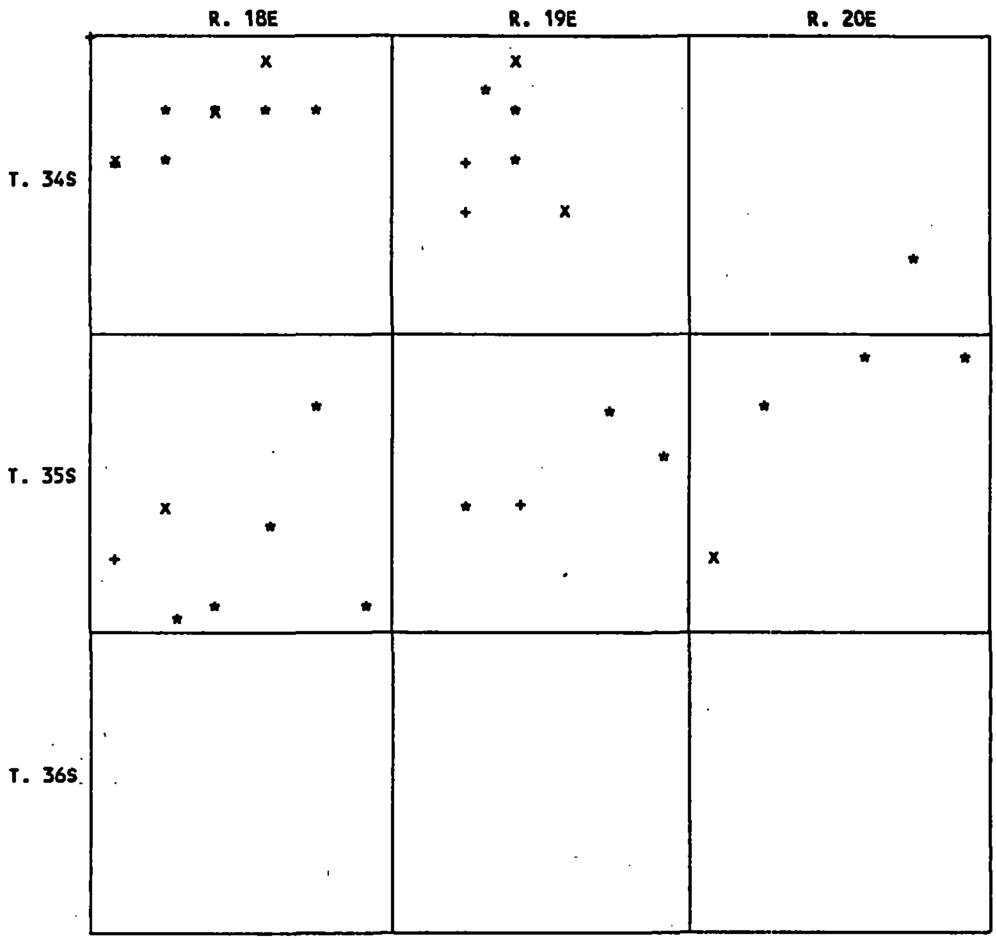



+ - WELL DEPTHS 0 - 99 FT.
x - WELL DEPTHS 100 - 199 FT.
* - WELL DEPTHS =>200 FT.

LITHOLOGIC WELL LOG PRINTOUT

SOURCE - FGS

WELL NUMBER: W- 6990
TOTAL DEPTH: 85 FT.
10 SAMPLES FROM 0 TO 100 FT.

COUNTY - MANATEE
LOCATION: T.35S R.19E S.21 CB
LAT = N 27D 25M 32S
LON = W 82D 24M 20S

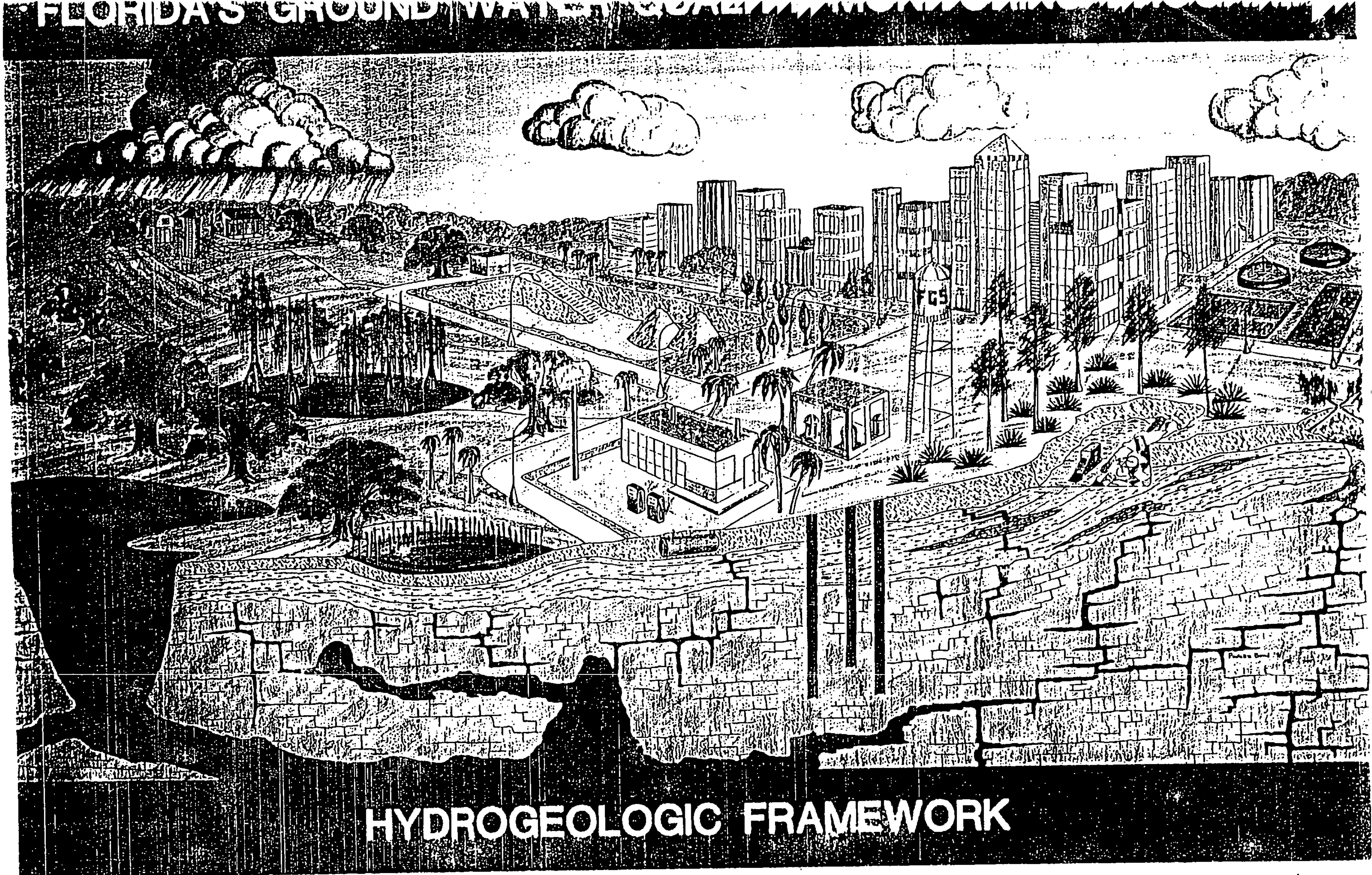
COMPLETION DATE - 25/11/64
OTHER TYPES OF LOGS AVAILABLE - NONE

ELEVATION - 39 FT

OWNER/DRILLER: JACK TAYLOR

WORKED BY: BY J. P. MAY COMPLETED 11/1973

| | |
|---|---|
| 0 - 10 | SAND; TRANSPARENT; INTERGRANULAR;<br>GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE;<br>ROUNDNESS: ROUNDED TO SUB-ANGULAR; UNCONSOLIDATED;<br>OTHER FEATURES: FROSTED;<br>FOSSILS: ORGANICS; |
| 10 - 20 | SAND; TRANSPARENT TO MODERATE BROWN; INTERGRANULAR;<br>GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE;<br>ROUNDNESS: ROUNDED TO SUB-ANGULAR; UNCONSOLIDATED;<br>ACCESSORY MINERALS: IRON STAIN- %, CLAY- %;<br>OTHER FEATURES: FROSTED; |
| 20 - 30 | SAND; TRANSPARENT TO DARK GRAY; INTERGRANULAR;<br>GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE;<br>ROUNDNESS:SUB-ANGULAR; UNCONSOLIDATED;<br>ACCESSORY MINERALS: PHOSPHATIC SAND-10%, PHOSPHATIC GRAVEL- 5%; |
| 30 - 40 | AS ABOVE |
| 40 - 40 | CLAY; LIGHT OLIVE GRAY; POOR INDURATION;<br>SEDIMENTARY STRUCTURES: FISSILE, |
| 40 | TOTAL DEPTH |




General - All Florida

# STATE OF FLORIDA

DEPARTMENT OF NATURAL RESOURCES
Tom Gardner, *Executive Director*

DIVISION OF RESOURCE MANAGEMENT
Jeremy Craft, *Director*

FLORIDA GEOLOGICAL SURVEY
Walter Schmidt, *State Geologist and Chief*

DEPARTMENT OF ENVIRONMENTAL REGULATION
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DIVISION OF WATER FACILITIES
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BUREAU OF DRINKING WATER AND GROUND WATER RESOURCES
Charles C. Aller, *Chief*

FLORIDA GEOLOGICAL SURVEY SPECIAL PUBLICATION NO. 32

## FLORIDA'S GROUND WATER QUALITY MONITORING PROGRAM

## HYDROGEOLOGICAL FRAMEWORK

COORDINATED BY

Rick Copeland, P.G. #126

EDITED BY

Thomas M. Scott, P.G. #99
Jacqueline M. Lloyd, P.G. #74
and
Gary Maddox

Published for the

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1991

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# ILLUSTRATIONS

# A GEOLOGICAL OVERVIEW OF FLORIDA

By

Thomas M. Scott, P.G. #99

## Introduction

The State of Florida lies principally on the Florida Platform. The western panhandle of Florida occurs in the Gulf Coastal Plain to the northwest of the Florida Platform. This subdivision is recognized on the basis of sediment type and depositional history. The Florida Platform extends into the northeastern Gulf of Mexico from the southern edge of the North American continent. The platform extends nearly four hundred miles north to south and nearly four hundred miles in its broadest width west to east as measured between the three hundred foot isobaths. More than one-half of the Florida Platform lies under water leaving a narrow peninsula of land extending to the south from the North American mainland.

A thick sequence of primarily carbonate rocks capped by a thin, siliciclastic sediment-rich sequence forms the Florida Platform. These sediments range in age from mid-Mesozoic (200 million years ago [mya]) to Recent. Florida's aquifer systems developed in the Cenozoic sediments ranging from latest Paleocene (55 mya) to Late Pleistocene (<100,000 years ago) in age (Figure 4). The deposition of these sediments was strongly influenced by fluctuations of sea level and subsequent subaerial exposure. Carbonate sediment deposition dominated the Florida Platform until the end of the Oligocene Epoch (24 mya). The resulting Cenozoic carbonate sediment accumulation ranges from nearly two thousand feet thick in northern Florida to more than five thousand feet in the southern part of the state. These carbonate sediments form the Floridan aquifer system, one of the world's most prolific aquifer systems, regional intra-aquifer confining units and the sub-Floridan confining unit. The sediments supradjacent to the Floridan aquifer system include quartz sands, silts, and clays (siliciclastics) with varying admixtures of carbonates as discrete beds and sediment matrix. Deposition of these sediments occurred from the Miocene (24 mya) to the Recent. The Neogene (24 mya to 1.6 mya) and Quaternary (1.6 mya to the present) sediments form the intermediate aquifer system and/or confining unit and the surficial aquifer system (Figure 4).

## Geologic History

Florida's basement rocks, those rocks older than Early Jurassic (>200 mya), are a fragment of the African Plate which remained attached to the North American Plate when the continents separated in the mid-Mesozoic. This fragment of the African Plate provided the base for the development of a carbonate platform which included the Bahama Platform and the Florida Platform (Smith, 1982). The Florida Straits separated the Bahama Platform from the Florida Platform by the beginning of the Late Cretaceous (approximately 100 mya) (Sheridan et al., 1981).

Carbonate sediments dominated the depositional environments from the mid-Mesozoic (approximately 145 mya) in southern and central Florida and from the earliest Cenozoic (approximately 62 mya) in northern and the eastern panhandle Florida. Carbonate sedimentation predominated in the Paleogene (67 to 24 mya) throughout most of Florida. Evaporite sediments, gypsum, anhydrite and some halite (salt), developed periodically due to the restriction of circulation in the carbonate depositional environments. The evaporites are most common in the Mesozoic and the Paleogene carbonates at and below the base of the Floridan aquifer system, where they help form the impermeable sub-Floridan confining unit.

During the early part of the Cenozoic, the Paleogene, the siliciclastic sediment supply from the north, the Appalachian Mountains, was limited. The mountains had eroded to a low level through millions of years of erosion. The minor amount of sediment reaching the marine environment was washed away from the Florida Platform by currents in the Gulf Trough (Suwannee Straits) (Figures 5a and b). This effectively protected the carbonate depositional environments of the platform from the influx of the siliciclastic sediments. As a result, the carbonates of the Paleogene section are very pure, with extremely limited quantities of siliciclastic sediments. In the central and western panhandle areas, which are part of the Gulf Coastal Plain, siliciclastic deposition continued well into the Paleogene. Significant carbonate deposition did not begin in this area until the Late Eocene (40 mya). During the later Eocene, as the influx of siliciclastics declined dramatically, carbonate depositional environments developed to the north and west of the limits of the Florida Platform. Carbonate deposition was continuous in the central panhandle and intermittent in the western panhandle through the Late Oligocene (approximately 28 mya).

During the Late Oligocene to Early Miocene, an episode of renewed uplift occurred in the Appalachians (Stuckey, 1965). With a renewed supply of sediments being eroded and entering the fluvial transport systems, siliciclastic sediments flooded the marine environment near the southeastern North American coastline. The influx of massive quantities of these sediments filled the Gulf Trough and encroached onto the carbonate platform through longshore transport, currents and other means. At first, the sands and clays were mixed with the carbonate sediments. Later, as more and more siliciclastics were transported south, the carbonate sediment deposition declined to only limited occurrences. Siliciclastic sediments, with varying amounts of carbonate in the matrix, dominated the depositional environments. The carbonate depositional environments were pushed further to the south until virtually the entire platform was covered with sands and clays. The influx of siliciclastics has diminished somewhat during the later Pleistocene and the Recent resulting in carbonate deposition occurring in limited areas around the southern portion of the Florida Platform.

The Miocene-aged siliciclastics appear to have completely covered the Florida Platform providing a relatively impermeable barrier to the vertical migration of ground water (Stringfield, 1966; Scott, 1981). This aquiclude protected the underlying carbonate sediments from dissolution. Erosion breached the confining unit by the early Pleistocene (?) allowing aggressive waters to dissolve the underlying carbonates. The progressive dissolution of the limestones enhanced the secondary porosity of the near-surface sediments of the Floridan aquifer system and allowed the development of numerous karst features.

Karst features formed in the Florida peninsula at least as early as the latest Oligocene as determined from the occurrence of terrestrial vertebrate faunas (MacFadden and Webb, 1982). Based on subsurface data from the interpretation of FGS cores, it appears that the development of karst in Florida occurred during the Paleogene. Unpublished work by Hammes and Budd (progress report to the FGS, U. Hammes and D. Budd, University of Colorado, 1990) indicates the occurrence of numerous "intraformational disconformities" which resulted in the development of "karst, caliche and other subaerial exposure features...". These disconformities were the result of sea level fluctuations on a very shallow water, carbonate bank depositional environment. At this time there is no documentation of large scale karst features forming during these episodes of exposure.

## Structure

The oldest structures recognized as affecting the deposition of sediments of the Florida Platform are expressed on the pre-Middle Jurassic erosional surface (Arthur, 1988). These include the Peninsular Arch, South Florida Basin, Southeast Georgia Embayment, Suwannee Straits and the Southwest Georgia Embayment or Apalachicola Embayment (Figure 5a). These structures affected the deposition of the Mesozoic sediments and the Early Cenozoic (Paleogene) sediments. The structures recognized on the top of the Paleogene section are somewhat different than the older features. The younger features, which variously affected the deposition of the Neogene and Quaternary sediments, include the Ocala Platform, Sanford High, Chattahoochee Anticline, Apalachicola Embayment, Gulf Trough, Jacksonville Basin (part of the Southeast Georgia Embayment), Osceola Low and the Okeechobee Basin (Figure 5b). For more specific information on these structures and their origins refer to Chen (1965), Miller (1986) and Scott (1988a).

The occurrence and condition of the aquifer systems are directly related to their position with respect to the structural features. The Floridan aquifer system lies at or near the surface under poorly confined to unconfined conditions on the positive features such as the Ocala Platform, Sanford High and the Chattahoochee Anticline. Within the negative areas, (the Apalachicola Embayment, Jacksonville Basin, Osceola Basin and the Okeechobee Basin) the Floridan aquifer system is generally well confined. The intermediate aquifer system is generally absent from the positive structures and best developed in the negative areas. The surficial aquifer system may occur anywhere in relation to these structures where the proper conditions exist.

The occurrence and development of the beds confining the Floridan aquifer system also relate to the subsurface structures. On some of the positive areas (Ocala Platform and Chattahoochee Anticline) the confining beds of the intermediate confining unit are absent due to erosion and possibly nondeposition. In those areas where the confining units are breached, dissolution of the carbonate sediments developed a karstic terrain. Dissolution of the limestones enhanced the porosity and permeability of the Floridan aquifer system including the development of some cavernous flow systems.

### Geomorphology

Florida's land surface is relatively flat and has very low relief. The surface features of Florida are the result of the complex interaction of depositional and erosional processes. As sea level fluctuated during the later Cenozoic, the Florida Platform has repeatedly been inundated by marine waters resulting in marine depositional processes dominating the development of Florida's geomorphology. The relict shoreline features found throughout most of the state are most easily identified at lower elevations, nearer the present coastline. Inland and at higher elevations, these features have been subjected to more extensive erosion and subsequent modification by wind and water. In those areas of the state where carbonate rocks and shell-bearing sediments are subjected to dissolution, the geomorphic features may be modified by development of karst features. The extent of the modification ranges from minor sagging due to the slow dissolution of carbonate or shell to the development of large collapse sinkholes. The changes that result may make identification of the original features difficult.

White (1970) subdivided the State into three major geomorphic divisions, the northern or proximal zone, the central or mid-peninsular zone and the southern or distal zone (Figure 6). The northern zone encompasses the Northwest Florida Water Management District and the northern portions of the Suwannee River and St. Johns River Water Management Districts. The central zone includes the southern portions of the Suwannee River and St. Johns River Water Management Districts, the Southwest Florida Water Management District and the northern part of the South Florida Water Management District. The southern zone comprises the remainder of the South Florida Water Management District.

In a broad general sense, the geomorphology of Florida consists of the Northern Highlands, the Central Highlands and the Coastal Lowlands (White, Vernon and Puri in Puri and Vernon, 1964). White (1970) further subdivided these features as shown in Figures 7 thru 11. In general, the highlands are well drained while the lowlands often are swampy, poorly drained areas. The highland areas as delimited by White, Vernon and Puri in Puri and Vernon (1964) often coincide with the areas of "high recharge" as recognized by Stewart (1980). Only a few, limited areas of "high recharge" occur in the Coastal Lowlands.

Many of the highland areas in the peninsula to the central panhandle exhibit variably developed karst features. These range from shallow, broad sinkholes that develop slowly to those that are large and deep and develop rapidly (Sinclair and Stewart, 1985). The development of the karst features and basins has a direct impact on the recharge in the region. The karst features allow the rapid infiltration of surface water into the aquifer systems and offer direct access to the aquifers by pollutants.

### Lithostratigraphy and Hydrostratigraphy

The aquifer systems in Florida are composed of sedimentary rock units of varying composition and induration which are subdivided into geologic formations based on the lithologic characteristics (rock composition and physical characteristics). Lithostratigraphy is the formal recognition of the defined geologic formations based on the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 1983). Many units are related by the similarities of the sediments while others may be defined on the sediment heterogeneity. An aquifer is a body of sediment or rock that is sufficiently permeable to conduct ground water and to yield economically significant quantities of water to wells and springs (Bates and Jackson, 1987). Florida's primary aquifers are referred to as aquifer systems due to the complex nature of the water-producing zones they contain. The aquifer systems are identified independently from lithostratigraphic units and may include more than one formation or be limited to only a portion of a formation. The succession of hydrostratigraphic units forms the framework used to discuss the ground-water system in Florida (Figure 4) (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

The lithostratigraphic and hydrostratigraphic framework of Florida shows significant variability from north to south and west to east in the peninsula and the panhandle. The formational units discussed are only those Cenozoic sediments that relate to the Floridan aquifer system, the intermediate aquifer system/confining unit and the surficial aquifer system.

## LITHOSTRATIGRAPHY

The lithostratigraphic units that comprise the aquifer systems in Florida occur primarily as subsurface units with very limited surface exposures. As a result of the generally low relief of the state, virtually all the lithostratigraphic descriptions are from well cuttings and cores used to study the sediments. Geophysical logs have proven useful in studying the sediments and attempting regional correlations (Chen, 1965; Miller, 1986; Scott, 1988a; Johnson, 1984).

The following description of the lithologic parameters of the various units associated with the aquifer systems is brief and generalized. More complete information concerning these groups and formations can be obtained by referring to Florida Geological Survey and U. S. Geological Survey publications relating to specific areas and/or specific aquifers. State-wide data concerning the thickness and tops of sediments of Paleocene (67-55 mya) and Eocene (55-38 mya) age (chronostratigraphic units) can be found in Chen (1965) and Miller (1986). Miller (1986) provides this data for Oligocene (38-25 mya) and Miocene (25-5.3 mya) sediments. Scott (1988a) provides detailed information on the Miocene strata in the eastern panhandle and peninsular areas. The Plio-Pleistocene (5.3-.01 mya) and the Holocene (.01 mya -Present) sediments which make up the surficial aquifer system, are discussed in a number of references which are cited in the appropriate section of this paper. Figure 4 shows the lithostratigraphic nomenclature utilized in this text.

### Cenozoic Erathem
### Tertiary System
### Paleocene Series

In general, most of the Paleocene sediments in the Florida peninsula form the sub-Floridan confining unit and only a limited portion of these rocks are part of the Floridan aquifer system. Siliciclastic sediments predominate in the Paleocene section in much of the panhandle (Chen, 1965; Miller, 1986). The siliciclastic sediments are composed of low permeability marine clays, fine sands and impure limestone (Miller, 1986) which lie below the base of the Floridan aquifer system. Following Miller (1986), the siliciclastic sediments are referred to as "Undifferentiated Paleocene Rocks (Sediments)" and are not discussed further.

The siliciclastic sediments grade laterally into carbonate sediments across the Gulf Trough in the eastern panhandle (Chen, 1965). Carbonate sediments, mostly dolostone, occur interbedded with evaporite minerals throughout the Paleocene section in the peninsula (Chen, 1965). These sediments are included in the Cedar Keys Formation and occur throughout the peninsular area and into the eastern panhandle.

#### Cedar Keys Formation

The Cedar Keys Formation consists primarily of dolostone and evaporites (gypsum and anhydrite) with a minor percentage of limestone (Chen, 1965). The upper portion of the Cedar Keys consists of coarsely crystalline, porous dolostone. The lower portion of the Cedar Keys Formation contains more finely crystalline dolostone which is interbedded with anhydrite. The Cedar Keys Formation grades into the Undifferentiated Paleocene Sediments in the eastern panhandle (Miller, 1986) which equate with the Wilcox Group (Braunstein et al., 1988).

The configuration of the Paleocene sediments in peninsular Florida reflect depositional controls inherited from the pre-existing Mesozoic structures, including the Peninsular Arch, Southeast Georgia Embayment, and the South Florida Basin (Miller, 1986). The Cedar Keys Formation forms the base of the Floridan aquifer system throughout the peninsula except in the northwestern-most peninsular area where the Oldsmar Formation forms the base (Miller, 1986). The upper, porous dolostone comprises the lowest beds of the Floridan aquifer system. The lower Cedar Keys Formation is significantly less porous, contains evaporites and forms the sub-Floridan confining unit.

### Eocene Series

The sediments of the Eocene Series that form portions of the Floridan aquifer system are carbonates. During the Early Eocene, deposition followed a distribution pattern similar to the Paleocene carbonate sediments. However, through the Eocene, carbonate-forming environments slowly encroached further north and west over what had been siliciclastic depositional environments during the Paleocene. The Eocene carbonate sediments are placed in the Oldsmar Formation, Avon Park Formation and the Ocala Group. The Eocene carbonate sediments comprise a large part of the Floridan aquifer system.

#### Claiborne Group

The Lower to Middle Eocene Claiborne Group unconformably (?) overlies the undifferentiated Lower Eocene and Paleocene sediments. The Claiborne Group consists of the Tallahatta and Lisbon Formations which are lithologically nearly identical and are not separated. The group is composed of glauconitic, often clayey sand grading into fine-grained limestone to the south (Allen, 1987). The Claiborne Group ranges from 250 to 400 feet below NGVD and is up to 350 feet thick (Allen, 1987). It is unconformably overlain by the Ocala Limestone.

#### Oldsmar Formation

The Oldsmar Formation consists predominantly of limestone interbedded with vuggy dolostone. Dolomitization is usually more extensive in the lower portion of the section. Pore-filling gypsum and thin beds of anhydrite occur in some places, often forming the base of the Floridan aquifer system (Miller, 1986).

The Oldsmar Formation is recognized throughout the Florida peninsula. It grades laterally in the eastern panhandle into Undifferentiated Lower to Middle Eocene sediments equivalent to the Claiborne Group. The undifferentiated sediments are marine shales, siltstones, fine sandstones and impure limestones (Miller, 1986).

#### Avon Park Formation

The Middle Eocene sediments of peninsular Florida as originally described by Applin and Applin (1944) were subdivided, in ascending order, into the Lake City Limestone and the Avon Park Limestone. Miller (1986) recommended the inclusion of the Lake City in the Avon Park based on the very similar nature of the sediments. Miller also changed the term limestone to formation due to the presence of significant quantities of dolostone within the expanded Avon Park Formation.

The Avon Park Formation is primarily composed of fossiliferous limestone interbedded with vuggy dolostone. In a few, limited areas of west-central Florida, evaporites are present as vug fillings in dolostone.

The Avon Park Formation occurs throughout the Florida peninsula and the eastern panhandle in a pattern very similar to the underlying Oldsmar Formation. The oldest rocks cropping out in Florida belong to the Avon Park Formation. These sediments are locally exposed on the crest of the Ocala Platform in west-central peninsular Florida.

The carbonate sediments of the Avon Park Formation form part of the Floridan aquifer system and serve to subdivide it into an upper and lower Floridan in many areas. Miller (1986) recognized that portions of the Avon Park Formation are fine-grained and have low permeability, often acting as a confining bed in the middle of the Floridan aquifer system. In Brevard County, for example, these low permeability beds are relied upon to keep less desirable water injected into the lower Floridan from migrating into the potable water of the upper Floridan.

#### Ocala Limestone

Dall and Harris (1892) referred to the limestones exposed in central peninsular Florida near the city of Ocala in Marion County as the Ocala Limestone. Puri (1957) raised the Ocala to group and recognized formations based on the incorporated foraminiferal faunas. As a result of the biostratigraphic nature of these subdivisions, formational recognition is often difficult. In keeping with the intent of the Code of Stratigraphic Nomenclature, in this text, the Florida Geological Survey is returning to the use of the Ocala Limestone terminology.

The lower and upper subdivisions of the Ocala Limestone are based on distinct lithologic differences. The lower subdivision consists of a more granular limestone (grainstone to packstone). The lower facies is not present everywhere and may be partially to completely dolomitized in some regions (Miller, 1986). The upper unit is composed of variably muddy (carbonate), granular limestone (packstone to wackestone with very limited grainstone). Often this unit is very soft and friable with numerous large foraminifera. In southern Florida, virtually the entire Ocala Limestone consists of a muddy (carbonate) to finely pelletal limestone (Miller, 1986). Chert is a common component of the upper portion of the Ocala Limestone. The Bumpnose "Formation", a very early Oligocene fossiliferous limestone, is lithologically very similar to the Ocala Limestone. It is included in the Ocala Limestone in this report.

The sediments of the Ocala Limestone form one of the most permeable zones within the Floridan aquifer system. The Ocala Limestone comprises much of the Floridan aquifer system in the central and western panhandle. The extensive development of secondary porosity by dissolution has greatly enhanced the permeability, especially in those areas where the confining beds are breached or absent. The Ocala Limestone forms the lower portion of the Floridan in the western panhandle (Wagner, 1982). In much of the peninsular area, it comprises all or part of the upper Floridan.

By Late Eocene, carbonate sediments were deposited significantly further to the north and west than had previously occurred during the Cenozoic. The Ocala Limestone is present throughout much of the State except where the unit has been erosionally removed. This occurs in outcrop on the crest of the Ocala Platform and in the subsurface on the Sanford High, a limited area in central Florida and a relatively large area in southernmost Florida (Miller, 1986). Chen (1965) suggests that the Ocala Limestone is also absent in a portion of Palm Beach County in eastern southern Florida. The surface and thickness of the Ocala Limestone are highly irregular due to dissolution of the limestones as karst topography developed.

### Oligocene Series

The carbonate sediments of the Oligocene Series form much of the upper portion of the Floridan aquifer system in Florida. The depositional pattern of the Oligocene sediments shows that carbonate sediments were deposited well updip to the north of the Florida Platform (Miller, 1986). In the central panhandle and to the west, siliciclastic sediments began to be mixed with the carbonates.

The Oligocene sediments in peninsular Florida and part of the panhandle are characteristically assigned to the Suwannee Limestone. The Oligocene sediments in the central and western panhandle are placed in the Marianna, Bucatunna and Chickasawhay Formations (Miller, 1986). In the westernmost panhandle, the lower carbonates of the Suwannee Limestone grade into the siliciclastic Byram Formation (Braunstein et al., 1988).

#### Suwannee Limestone

The Suwannee Limestone consists primarily of variably vuggy and muddy (carbonate) limestone (grainstone to packstone). The occurrence of a vuggy, porous dolostone is recognized in the type area; the eastern to central panhandle and in southwest Florida. The dolostone often occurs interbedded between limestone beds.

The Suwannee Limestone is absent throughout a large area of the northern and central peninsula probably due to erosion. Scattered outliers of Suwannee Limestone are present within this area. Where it is present, the Suwannee Limestone forms much of the upper portion of the Floridan aquifer system. The reader is referred to Miller (1986) for a map of the occurrence of the Suwannee Limestone in the peninsula.

Marianna Limestone

The Marianna Limestone is a fossiliferous, variably argillaceous limestone (packstone to wackestone) that occurs in the central panhandle. It is laterally equivalent to the lower portion of the Suwannee Limestone. The Marianna Limestone forms a portion of the uppermost Floridan aquifer system in the central panhandle region.

*Bucatunna Clay Member of the Byram Formation*

The Bucatunna Clay Member is silty to finely sandy clay. Fossils are generally scarce in the Bucatunna (Marsh, 1966). The sand content of the Bucatunna ranges from very minor percentages to as much as 40 percent (Marsh, 1966).

The Bucatunna Clay Member has a limited distribution in the western panhandle. It occurs from the western end of the state eastward to approximately the Okaloosa-Walton County line where it pinches out (Marsh, 1966). The Bucatunna Clay Member provides an effective intra-aquifer confining unit in the middle of the Floridan aquifer system in the western panhandle.

Chickasawhay Formation

Marsh (1966) describes the Chickasawhay Formation as being composed of highly porous limestone and dolomitic limestone. This is often interbedded with porous to compact dolomitic limestone to dolostone. The Chickasawhay Formation grades into the upper Suwannee Limestone eastward. Due to difficulty in separating the Chickasawhay from the Lower Miocene limestones in the western panhandle, both Marsh (1966) and Miller (1986) included thin beds of possible Lower Miocene carbonate in the upper portion of the Chickasawhay Formation. The permeable sediments of the Chickasawhay Formation form part of the upper Floridan in the western panhandle (Wagner, 1982).

Miocene Series

The Miocene Epoch was a time of significant change in the depositional sequence on the Florida Platform and the adjacent Gulf and Atlantic Coastal Plains. During the early part of the Miocene, carbonate sediments continued to be deposited over most of the State. Intermixed with the carbonates were increasing percentages of siliciclastic sediments. By the end of the Early Miocene, the deposition of carbonate sediments was occurring only in southern peninsular Florida. Siliciclastic deposition dominated the Middle Miocene statewide with this trend continuing into the Late Miocene.

The basal Miocene carbonate sediments often form the uppermost portion of the Floridan aquifer system. The remainder of the Miocene sediments form much of the intermediate aquifer system and intermediate confining system. In some instances, these sediments may also be included in the surficial aquifer system.

Unusual depositional conditions existed during the Miocene as is evident from the occurrence of abundant phosphate, palygorskite, opaline cherts and other uncommon minerals plus an abundance of dolomite within the Hawthorn Group (Scott, 1988a). The presence of these minerals may influence ground-water quality in areas where the Miocene sediments are being weathered. Ground-water quality may also be affected where these sediments form the upper portion of the Floridan aquifer system or portions of the intermediate aquifer system.

Current geologic thought holds that in the peninsula the Miocene section is composed of the Hawthorn Group. The Tampa Formation is included as a member in the basal Hawthorn Group. In the panhandle, the Lower Miocene remains the Chattahoochee and St. Marks Formations, the Middle Miocene Alum Bluff Group and the Upper Miocene Choctawhatchee Formation and equivalents. Formations previously mentioned in the literature as being Miocene in age include the Tamiami, which is Pliocene in age, and the Miccosukee Formation which is now recognized as being Late Pliocene to possibly early Pleistocene in age.

The Miocene sediments are absent from the Ocala Platform and the Sanford High (Scott, 1988a). These sediments are as much as 800 feet thick in southwest Florida (Miller, 1986; Scott, 1988a), 500 feet thick in the northeastern peninsula (Scott, 1988a) and 900 to 1000 feet thick in the westernmost panhandle (Miller, 1986).

Chattahoochee Formation

The Chattahoochee Formation is predominantly a fine-grained, often fossiliferous, silty to sandy dolostone which is variable to a limestone (Huddlestun, 1988). Fine-grained sand and silt may also form beds with various admixtures of dolomite and clay minerals. Clay beds may also be common in some areas (Puri and Vernon, 1964).

The Chattahoochee Formation occurs in a limited area of the central panhandle from the axis of the Gulf Trough westward. It appears that the Chattahoochee grades to the west into a carbonate unit alternately referred to as Tampa Limestone (Marsh, 1966; Miller, 1986) or St. Marks (Puri and Vernon, 1964; NWFWMD Staff, 1975). Northward into Georgia, this unit grades into the basal Hawthorn Group (Huddlestun, 1988). To the east of the axis of the Gulf Trough, the Chattahoochee Formation grades into the St. Marks Formation (Puri and Vernon, 1964; Scott, 1986). The gradational change between the Chattahoochee and St. Marks Formations occurs over a broad area of Leon and Gadsden Counties (Scott, 1986). The sediments of the Chattahoochee Formation comprise the upper zone of the Floridan aquifer system in the central panhandle.

St. Marks Formation

The St. Marks Formation is a fossiliferous limestone (packstone to wackestone). Sand grains occur scattered in an often very moldic limestone. The lithology of the St. Marks and the associated units in the Apalachicola Embayment and to the west are often difficult to separate (Schmidt, 1984). The St. Marks Formation lithology can be traced in cores grading into the Chattahoochee Formation (Scott, 1986). This formation forms the upper part of the Floridan aquifer system in portions of the eastern and central panhandle.

Hawthorn Group

The Hawthorn Group is a complex series of the phosphate-bearing Miocene sediments in peninsular and eastern panhandle Florida. The carbonate sediments of the Hawthorn Group are primarily fine-grained and contain varying admixtures of clay, silt, sand and phosphate. Dolostone is the dominant carbonate sediment type in the northern two-thirds of the peninsula while limestone predominates in the southern peninsula and in the eastern panhandle area.

The siliciclastic sediment component consists of fine- to coarse-grained quartz sand, quartz silt and clay minerals in widely varying proportions. The clay minerals present include palygorskite, smectite and illite with kaolinite occurring in the weathered sediments.

The top of the Hawthorn Group is a highly irregular erosional and karstic surface. This unconformable surface can exhibit dramatic local relief especially in outcrop along the flanks of the Ocala Platform. Figures 12 through 19 show the top and thickness of the Hawthorn Group sediments which comprise the intermediate aquifer system/confining unit.

In the peninsula, the Hawthorn Group can be broken into a northern section and a southern section. The northern section consists of interbedded phosphatic carbonates and siliciclastics with a trend of increasing siliciclastics in the younger sediments. In ascending order, the formations in northern Florida are the Penney Farms, Marks Head and Coosawhatchee and its lateral equivalent Statenville (Scott, 1988a). The sediments comprising these formations characteristically have low permeabilities and form an effective aquiclude, the intermediate confining unit. In a few areas, permeabilities within the Hawthorn sediments are locally high enough to allow the limited development of an intermediate aquifer system.

The southern section consists of a lower dominantly phosphatic carbonate section and an upper phosphatic siliciclastic section. In the southern area, in addition to increasing siliciclastics upsection, there is also a trend of increasing siliciclastics from west to east in the lower carbonate section. The Hawthorn Group in southern Florida has been subdivided into, in variable permeabilities and form the lower Tamiami aquifer and Tamiami confining beds of the surficial aquifer system (Knapp et al., 1986). Smith and Adams (1988) indicate that the upper Tamiami sediments form the basal portion of the "water table aquifer" overlying the Tamiami confining beds.

Citronelle Formation

The Citronelle Formation is composed of fine to very coarse siliciclastics. The name was extended to include the siliciclastics comprising the central ridge system in the Florida peninsula by Cooke (1945). As it is currently recognized, the Citronelle Formation occurs only in the panhandle. The unit is recognized from central Gadsden County on the east to the western boundary of the State. The Citronelle Formation is composed of very fine to very coarse, poorly sorted, angular to subangular quartz sand. The unit contains significant amounts of clay, silt and gravel which may occur as beds, lenses or stringers and may vary rapidly over short distances. Limonite nodules and limonitic cemented zones are common.

The Citronelle Formation extends over much of the central and western panhandle. Previous investigators encountered problems in the separation of the Citronelle and the overlying terrace deposits and generally considered the thickness of the Citronelle including these younger sediments (Marsh, 1966; Coe, 1979). The Citronelle Formation grades laterally into the Miccosukee Formation through a broad transition zone in Gadsden County. The Citronelle Formation forms an important part of the Sand-and-Gravel aquifer in the western panhandle and produces up to 2,000 gallons of water per minute (Wagner, 1982).

Miccosukee Formation

Hendry and Yon (1967) describe the Miccosukee Formation as consisting of interbedded and cross-bedded clay, silt, sand and gravel of varying coarseness and admixtures. Limonite pebbles are common in the unit. The Miccosukee Formation occurs in the eastern panhandle from central Gadsden County on the west to eastern Madison County on the east. Due to its clayey nature, the Miccosukee Formation does not produce significant amounts of water. It is generally considered to be part of the surficial aquifer system (Southeastern Geological Society, 1986).

Cypresshead Formation

The name Cypresshead Formation was first used by Huddlestun (1988). It was extended into Florida by Scott (1988b). The Cypresshead Formation is composed entirely of siliciclastics; predominantly quartz and clay minerals. The unit is characteristically a mottled, fine- to coarse-grained, often gravelly, variably clayey quartz sand. As a result of weathering, the clay component of these sediments has characteristically been altered to kaolinite. Clay serves as a binding matrix for the sands and gravels. Clay content may vary from absent to more than fifty percent in sandy clay lithologies although the average clay content is 10 to 20 percent. These sediments are often thinly bedded with zones of cross bedding. The Cypresshead Formation appears to occur in the Central Highlands of the peninsula south to northern Highlands County, although the extent of the Cypresshead Formation has not been accurately mapped in this area. This unit may locally comprise the surficial aquifer system where clay content is low.

Nashua Formation

The Nashua is a fossiliferous, variably calcareous, sometimes clayey, quartz sand. The fossil content is variable from a shelly sand to a shell hash. The dominant fossils are mollusks.

The extent of the Nashua in northern Florida is not currently known. It extends some distance into Georgia and appears to grade laterally into the Cypresshead Formation (Huddlestun, 1988). The Nashua Formation may produce limited amounts of water in localized areas where it forms part of the surficial aquifer system.

*Caloosahatchee Formation*

The Caloosahatchee Formation consists of fossiliferous quartz sand with variable amounts of carbonate matrix interbedded with variably sandy, shelly limestones. The sediments vary from non-indurated to well indurated. The fauna associated with these sediments are varied and often well preserved. Fresh water limestones are commonly present within this unit.

Sediments identified as part of the Caloosahatchee Formation by various investigators occur from north of Tampa on the west coast south to Lee County, eastward to the East Coast then northward into northern Florida (DuBar, 1974). The Caloosahatchee Formation as used here includes those sediments informally referred to as the Bermont formation (DuBar, 1974).

In most hydrogeologic investigations of southern Florida, the Caloosahatchee Formation is not differentiated from the Fort Thompson Formation and other faunal units. The undifferentiated sediments form much of the surficial aquifer system.

Fort Thompson Formation

The Fort Thompson Formation consists of interbedded shell beds and limestones. The shell beds are characteristically variably sandy and slightly indurated to unindurated. The sandy limestones present in the Fort Thompson Formation were deposited under both freshwater and marine conditions. The sand present in these sediments is fine- to medium-grained. The sediments of Fort Thompson age in central Florida along the east coast, consist of fine to medium quartz sand with abundant mollusk shells and a minor but variable clay content.

The Fort Thompson Formation, as the Caloosahatchee Formation, is part of the undifferentiated sediments in southern Florida. It forms a portion of the surficial aquifer system.

Key Largo Limestone

The Key Largo Limestone is a coralline limestone composed of coral heads encased in a matrix of calcarenite (Stanley, 1966). Hoffmeister and Multer (1968) indicate that the Key Largo Limestone occurs in the subsurface from as far north as Miami Beach to as far south as the Lower Keys. The fossil reef tract represented by the Key Largo sediments may be as much as 8 miles wide (DuBar, 1974). Near the northern and southern limits of the Key Largo Limestone, it is overlain conformably by the Miami Limestone with which the Key Largo is, in part, laterally equivalent.

The Key Largo Limestone forms a part of the Biscayne aquifer of the surficial aquifer system. The Biscayne aquifer provides water for areas of Dade, Broward and Monroe Counties.

Miami Limestone

The Miami Limestone includes an oolitic facies and a bryozoan facies. The bryozoan facies underlies and extends west of the western boundary of the oolitic facies. The bryozoan facies consists of calcareous bryozoan colonies imbedded in a matrix of ooids, pellets and skeletal sand. It generally occurs as a variably sandy, recrystallized, fossiliferous limestone (Hoffmeister et al., 1967). The oolitic facies consists of variably sandy limestone composed primarily of oolites with scattered concentrations of fossils.

Hoffmeister et al. (1967) indicate that the Miami Limestone covers Dade County, much of Monroe County and the southern part of Broward County. It grades laterally to the south into the Key Largo Limestone and to the north into the Anastasia Formation. The oolitic facies underlies the Atlantic Coastal Ridge southward from southern Palm Beach County to southern Dade County.

The Miami Limestone forms a portion of the Biscayne aquifer of the surficial aquifer system. It is very porous and permeable due to the dissolution of carbonate by ground water as it recharges the aquifer system.

*Anastasia Formation*

The Anastasia Formation consists of interbedded quartz sands and coquinoid limestones. The sand beds consist of fine to medium-grained, variably fossiliferous, calcareous, quartz sand. The contained fossils are primarily broken and abraided mollusk shells. The limestone beds, commonly called coquina, are composed of shell fragments, scattered whole shells and quartz sand enclosed in a calcareous matrix, usually sparry calcite cement.

The Anastasia Formation forms the Atlantic Coastal Ridge through most of its length (White, 1970). Natural exposures of this unit occur scattered along the east coast from St. Augustine south to southern Palm Beach County near Boca Raton. South of this area the Anastasia Formation grades into the Miami Limestone. Cooke (1945) felt that the Anastasia Formation extended no more than three miles inland from the Intracoastal Waterway. Field work by this author (Scott) suggests that the Anastasia may extend as much as 10 miles inland; although, Schroeder (1954) suggests that this unit may occur more than 20 miles inland.

The Anastasia Formation forms a portion of the surficial aquifer system along the eastern coast of the state. Ground water is withdrawn from the Anastasia Formation in many areas along the Atlantic Coastal Ridge where, locally, it may be the major source of ground water. Near the southern extent of the Anastasia Formation, it forms a portion of the Biscayne aquifer (Hoffmeister, 1974).

Undifferentiated Pleistocene-Holocene Sediments

The sediments referred to as the "undifferentiated Pleistocene-Holocene sediments" cover much of Florida effectively hiding most older sediments. Included in this category are marine "terrace" sediments, eolian sand dunes, fluvial deposits, fresh water carbonates, peats and a wide variety of sediment mixtures. These sediments often occur as thin layers overlying older formations and are not definable as formations. As such, these sediments have been referred to by many different names including Pliocene to Recent sands, Pleistocene sands, Pleistocene Terrace Deposits.

The sediments incorporated in this category are most often quartz sands. The sands range from fine- to coarse-grained, nonindurated to poorly indurated and nonclayey to slightly clayey. Gravel may be present in these sediments in the panhandle area. Other sediments included in this group include peat deposits, some clay beds, and freshwater carbonates. The freshwater carbonates occur in many freshwater springs and in large areas of the Everglades.

Locally, these sediments may form a portion of the surficial aquifer system. The greatest thicknesses of these sediments occurs infilling paleokarst features where more than 300 feet of undifferentiated Pleistocene-Holocene sediments have been recorded (Florida Geological Survey, unpublished well data).

## HYDROSTRATIGRAPHY

The hydrostratigraphy of the Florida Platform has been the focus of numerous investigations by the various water management districts, the USGS and the FGS. The hydrostratigraphic framework recognized in Florida consists of a thick sequence of Cenozoic sediments which comprise the Floridan aquifer system, the intermediate aquifer system/confining unit and the surficial aquifer system (Figure 4) (Southeastern Geological Society Ad Hoc Committee, 1986). The Floridan aquifer system underlies much of the State, providing abundant potable water for a rapidly expanding population (Figure 20). In limited areas throughout the State, the intermediate aquifer system is utilized. Water is also withdrawn from the surficial aquifer system in many areas particularly in the western panhandle and southern Florida. As an example, Figure 21 illustrates the extent and occurrence of ground-water systems in the NWFWMD area of the panhandle.

The hydrologic parameters of each aquifer system vary widely from one area of the state to another as do the lithologies of the sediments. Hydrologic subdivisions do not have to conform to the lithostratigraphic framework.

Each water management district has identified surface-water basins and ground-water areas. The surface-water basins (Figures 22 through 26) delineate the areas influenced by the tributaries of the major drainage features. The ground-water areas (Figures 27 through 31) were delineated as convenient study areas. Maps representing the potentiometric surface of the Floridan aquifer system were constructed for each district (Figures 32 through 36).

### Surficial aquifer system

The surficial aquifer system is defined by the Southeastern Geological Society (SEGS) Ad Hoc Committee on Florida Hydro-stratigraphic Unit Definition (1986) as "the permeable hydrologic unit contiguous with the land surface that is comprised principally of unconsolidated to poorly indurated, siliciclastic deposits. It also includes well-indurated carbonate rocks, other than those of the Floridan aquifer system where the Floridan is at or near land surface. Rocks making up the surficial aquifer system belong to all or part of the Upper Miocene to Holocene Series. It contains the water table, and the water within it is under mainly unconfined conditions; but beds of low permeability may cause semi-confined or locally confined conditions to prevail in its deeper parts. The lower limit of the surficial aquifer system coincides with the top of the laterally extensive and vertically persistent beds of much lower permeability".

Some areas of the state rely heavily upon the surficial aquifer system for potable water in areas where the water quality of the Floridan aquifer system is poor. The two main aquifers of the surficial aquifer system to which names have been applied are the Sand and Gravel Aquifer of northwestern panhandle Florida and the Biscayne Aquifer in southeastern Florida. The distribution of these aquifers is limited (Figure 20). Maps delineating the thickness of the surficial aquifer system were provided by the Northwest Florida Water Management District (NWFWMD) (Figure 37) and Southwest Florida Water Management District (SWFWMD) (Figure 38). The South Florida Water Management District provided a map of the base of the surficial aquifer system (Figure 39). Figure 40 depicts those areas of the SJRWMD where the surficial aquifer system is a primary ground-water supplier.

The surficial aquifer system is composed of Pliocene to Holocene quartz sands, shell beds and carbonates (Figure 4). In the Florida panhandle, these units include the Citronelle and Miccosukee Formations and undifferentiated sediments. In the northern portion of the peninsula, sediments belonging to the Anastasia Formation, Cypresshead Formation and Undifferentiated Sediments, which include shell beds and limestones that are time equivalent to the Caloosahatchee and Fort Thompson Formations, comprise the surficial aquifer system. In southern Florida, the surficial aquifer system consists of the Tamiami, Caloosahatchee, Fort Thompson, and Anastasia Formations, the Key Largo and Miami Limestones and the undifferentiated sediments. Following the definition of the Tamiami as proposed by Hunter and Wise (1980), the portion of the Tamiami previously considered to be the lower Tamiami confining unit now forms the upper part of the Hawthorn Group of the intermediate confining unit. Where a clay bed separates the upper and lower limestones of the Tamiami, as in Hendry County (Smith and Adams, 1988), the clay bed is recognized as a thin confining unit within the surficial aquifer system.

### Intermediate aquifer system/confining unit

The SEGS (1986) defines the intermediate aquifer system/ confining unit as "all rocks that lie between and collectively retard the exchange of water between the overlying surficial aquifer system and the underlying Floridan aquifer system. These rocks in general consist of fine-grained siliciclastic deposits interlayered with carbonate strata belonging to all or parts of the Miocene and younger series. In places, poorly-yielding to non-water-yielding strata mainly occur and there the term "intermediate confining unit" applies. In other places, one or more low- to moderate-yielding aquifers may be interlayered with relatively impermeable confining beds; there the term "intermediate aquifer system" applies. The aquifers within this system contain water under confined conditions.

The top of the intermediate aquifer system/confining unit "coincides with the base of the surficial aquifer system. The base of the intermediate aquifer [or confining unit] is at the top of the vertically persistent, permeable, carbonate section that comprises the Floridan aquifer system, or, in other words, that place in the section where siliciclastic layers of significant thickness are absent and permeable carbonate rocks are dominant. Where the upper layers of the persistent carbonate section are of low permeability, they are part of either the intermediate aquifer system or intermediate confining unit, as applicable to the area."

The sediments comprising the intermediate aquifer system/confining unit exhibit wide variability over the state. In the central and western panhandle, this section acts principally as an intermediate confining unit for the Floridan aquifer system. The formations belonging to the intermediate confining unit include the Alum Bluff Group, Pensacola Clay, Intracoastal Formation, and the Chipola Formation (SEGS, 1986). In the eastern panhandle, the confining unit includes primarily the

Hawthorn Group sediments. Figures 41 and 42 show the top and thickness of the intermediate confining unit in the NWFWMD area while Figures 12 and 13 show the top and thickness of the Hawthorn Group sediments in the eastern part of the District. In the northern peninsula, the Hawthorn Group sediments form the intermediate confining unit with minor occurrences of aquifer zones (Figures 14 through 17). In the southern peninsula, the Hawthorn Group sediments form both an intermediate confining unit and an intermediate aquifer system. The top and thickness of the intermediate aquifer system/confining unit in the SWFWMD area is shown in Figures 43 and 44. The top and isopach of the Hawthorn Group sediments in southern Florida (SWFWMD and SFWMD) are shown on Figures 18 and 19. In many areas of the state, impermeable carbonates of Eocene and Oligocene age may form the base of the intermediate confining unit. Conversely, permeable carbonates occurring at the base of the Hawthorn Group may be hydraulically connected to the Floridan aquifer system and locally form the top of the Floridan.

The intermediate aquifer system plays a very important role in the ground-water resources of southwestern peninsular Florida. In the Lee County and surrounding areas, the intermediate aquifer system provides relatively large quantities of potable water. The Hawthorn Group may contain two producing zones (Wedderburn et al., 1982) referred to as the mid-Hawthorn aquifer and the sandstone aquifer. Figure 45 illustrates the top of the mid-Hawthorn confining zone in Lee County. Figure 46 delineates the base of the sandstone aquifer while Figure 47 shows the top of the mid-Hawthorn aquifer.

The intermediate confining unit occurs widespread in the state providing an effective aquiclude for the Floridan aquifer system. On the crests of the Ocala Platform, Sanford High, St. Johns Platform, Brevard Platform and the Chattahoochee Anticline (Figure 4) these beds are absent due to erosion. In these areas, surface water has a direct avenue to recharge the Floridan aquifer system. Immediately surrounding these areas, the intermediate confining unit is present but is breached by karst features which also allow surface water and water from the surficial and intermediate aquifer systems direct access to the Floridan. In the west-central portion of the peninsula and along the west coast from Hillsborough County into the eastern panhandle, the intermediate confining unit is generally absent and the Floridan aquifer system occurs unconfined. In the east-central peninsula, the intermediate confining unit is thin and provides only limited confinement for the underlying Floridan aquifer system. Miller (1986) mapped a maximum thickness of the intermediate confining unit as being greater than 1000 feet thick in the western-most panhandle and in southwestern Florida.

Floridan aquifer system

The Floridan aquifer system is one of the world's most productive aquifers. The sediments that comprise the aquifer system underlie the entire state although potable water is not present everywhere (Figure 20).

The Floridan aquifer system may occur as a continuous series of vertically connected carbonate sediments or may be separated by sub-regional to regional confining beds (Miller, 1986). Often the confining beds consist of low permeability carbonates. In the western panhandle, the intra-aquifer confining unit is the Bucatunna Clay. Elsewhere, the confining beds are carbonate sediments belonging to the Ocala Limestone, Avon Park Formation or the Oldsmar Formation. When intra-aquifer confining beds are present, the Floridan aquifer system can be subdivided into an upper and lower Floridan. Figures 48 through 51 indicate the configuration of the top and the thickness of the upper and lower limestones of the Floridan aquifer system. Figures 52 and 53 reveal the top and thickness of the Bucatunna Clay, the intra-aquifer confining unit in the western panhandle. Figure 54 shows the top of the lower Floridan aquifer system in the SJRWMD area.

The Floridan aquifer system in peninsular Florida and the eastern panhandle is composed of all or parts of the Cedar Keys Formation, Oldsmar Formation, Avon Park Formation, Ocala Limestone, Suwannee Limestone, St. Marks Formation and, possibly, the basal carbonates of the Hawthorn Group in limited areas of the state (Figure 4). The Floridan aquifer system encompasses the Ocala Limestone, Marianna Limestone, Suwannee Limestone, Chickasawhay Limestone, Chattahoochee Formation, St. Marks Formation and Bruce Creek Limestone (Figure 4) in the central and western panhandle.

The elevation of the upper surface of the Floridan aquifer system is directly related to the positioning on the major structural features (Figure 5). The top of the Floridan aquifer system ranges in elevation from greater than +100 feet NGVD on the Ocala Platform and Chattahoochee Arch to more than -1400 feet NGVD in the western-most panhandle and more than -1100 feet NGVD in the Okeechobee Basin of southern Florida (Figures 55 through 59). The thickness of the Floridan aquifer system (including those areas where water from the Floridan aquifer system may not be potable) varies from less than 100 feet along the state line in north-central panhandle to more than 3000 feet in the Apalachicola Embayment and 3400 feet in southern peninsular Florida (Figures 60 through 64). The base of the Floridan aquifer system in the NWFWMD area is shown in Figure 65.

The degree of confinement of the Floridan aquifer system also varies in relation to the position of the major structural features. The Floridan may be unconfined or semiconfined on the major features including the Ocala Platform and the Chattahoochee Anticline (Figures 66 through 68). In the negative areas such as the Jacksonville Basin, Okeechobee Basin and the Gulf Coast Basin, the Floridan aquifer system is well confined. Many areas of central peninsular Florida and in the eastern panhandle exhibit the development of karst features that breach the confining unit allowing localized recharge to occur. Figure 69 illustrates the NWFWMD area karst development. Throughout most of southern Florida, particularly the SFWMD area, the Floridan aquifer system occurs under confined conditions. The thickness of the beds confining the Floridan aquifer system in the SWFWMD area is shown in Figure 70.

Recharge to the Floridan aquifer system is directly related to the confinement of the system. The highest recharge rates occur where the Floridan is unconfined or poorly confined as in those areas where the Floridan aquifer system is at or near land surface (Figure 71). Recharge may also be high in areas where the confining layers are breached by karst features as shown for the NWFWMD area (Figure 69). Figures 72 through 76 indicate the relative recharge rates around the state.

The potentiometric surface of the Floridan aquifer system varies widely throughout the state. In localized areas, the potentiometric surface may be affected by intensive pumpage of ground water. Figures 32 through 36 indicate the elevation of this surface relative to NGVD. In those areas where the potentiometric surface is higher than the ground elevation, artesian conditions occur. Figures 77 through 82 delineate the areas where artesian flow is expected based on current data.

The intrusion of saline waters into fresh water producing zones is a major concern for Florida's coastal, and some inland, communities. Excessive pumpage of fresh water may draw the saline waters laterally or may cause an upconing of underlying nonpotable water. The salt water that can affect the potable water supply may be connate water trapped during the deposition of the sediments forming the aquifer system. It may represent saline waters that entered the aquifer system during previous high sea level stands which have not been flushed from the aquifer. The limits of salt water intrusion are shown on Figures 83 through 86.

The Claiborne aquifer occurs in a limited area of the central-northern panhandle. It is a permeable portion of the sub-Floridan Confining Unit in that area. It is poorly defined and rarely used at this time (Allen, 1987).

## CONCLUSION

This volume presents a review of the current knowledge of the Cenozoic lithostratigraphy and hydrostratigraphy as it relates to ground water in Florida. This publication represents the efforts of the five water management districts, the Department of Environmental Regulation and the Florida Geological Survey, Department of Natural Resources to provide a geologic framework of the state's ground-water resources. Recognition of the geologic framework of the aquifer systems and confining units is imperative for determining and understanding the ambient ground-water quality in Florida. Through recognizing the geologic framework, areas that are particularly sensitive to pollution may be defined and proper ground-water management techniques can be applied to protect these resources.

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## APPENDIX 1

### Additional Sources of Information

ALACHUA COUNTY DEPARTMENT OF ENVIRONMENTAL SERVICES
#1 Southwest 2nd Place
Gainesville, Florida 32606
(904) 336-2442

DADE COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCE MANAGEMENT
111 Northwest 1st Street
Suite 1310
Miami, Florida 33128
(305) 375-3318

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
Bureau of Drinking Water and Ground Water Resources
Ground Water Quality Monitoring Section
2600 Blair Stone Road
Tallahassee, Florida 32399
(904) 488-3601

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
Route 1, Box 3100
Havana, Florida 32333
(904) 539-5999

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
P.O. Box 1429
Palatka, Florida 32078
(904) 328-8321

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
P.O. Box 24680
3301 Gun Club Road
West Palm Beach, Florida 33416
(407) 694-0546

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
Tampa Service Office
7601 U.S. 301 North
Tampa, Florida 33637
(813) 985-7481

SUWANNEE RIVER WATER MANAGEMENT DISTRICT
Route 3, Box 64
Live Oak, Florida 32060
(904) 362-1001

#### Database and Software Distributors

FLORIDA SUMMARY MAPPING SYSTEM (FSMS) -
Land Use Database:

Automated Resource Mapping & Analysis Systems Integration
(ARMASI, Inc.)
P.O. Box 13027
Gainesville, Florida 32607
(904) 462-2955

WELL LOG DATA SYSTEM (WLDS) - Well Log Analysis Software:

GeoLogic Information Systems
P.O. Box 15224
Gainesville, Florida 32604
(904) 338-1128

Well Log Data can be obtained from:

FLORIDA GEOLOGICAL SURVEY
903 West Tennessee Street
Tallahassee, Florida 32304-7700
(904) 488-9380

GENERALIZED WELL INFORMATION SYSTEM (GWIS), DERMAP (Integral Mapping Package for GWIS, WLDS, FSMS), Ground Water Quality Data (GWIS or dBASE III + format):

Florida Department of Environmental Regulation
Bureau of Drinking Water and Ground Water Resources
Ground Water Quality Monitoring Section
2600 Blair Stone Road
Tallahassee, Florida 32399-2400
(904) 488-3601

Computer Bulletin Board System (904) 487-3592

* The BBS (Computer Bulletin Board) allows access to GWIS and the most recent water quality data from any PC with a modem, telephone line and communications software. The BBS runs 24 hours a day, seven days a week. Users can either run GWIS remotely, performing retrievals and then downloading the results, or can download the full program and data sets for use on another PC.

DERMAP and GWIS are also available on disk by mail, for a small media fee. Contact the DER staff for further information.

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**SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT:**

Moore, D.L., D.W. Martin, S.T. Walker and J.T. Rauch
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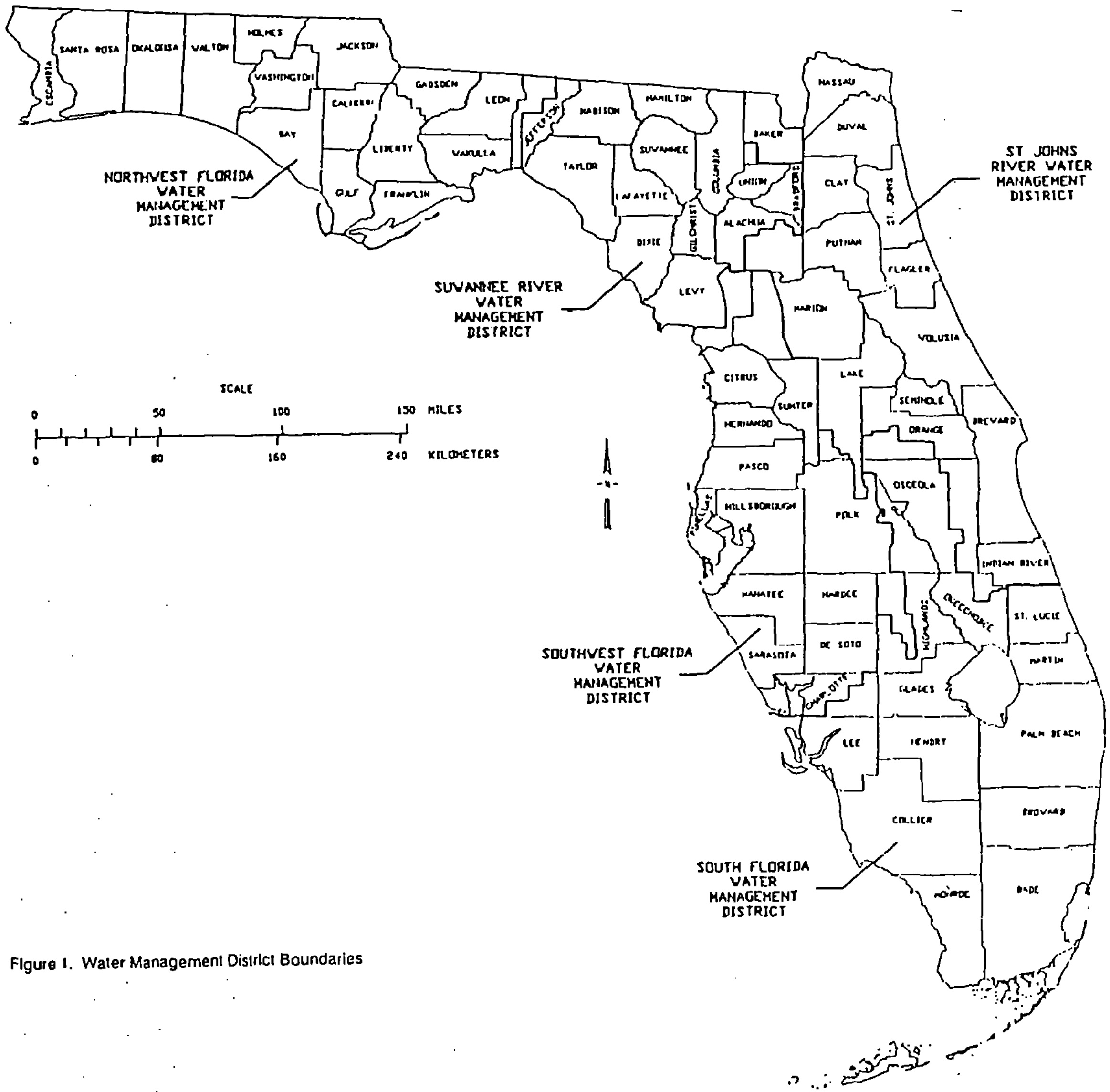


Figure 1. Water Management District Boundaries

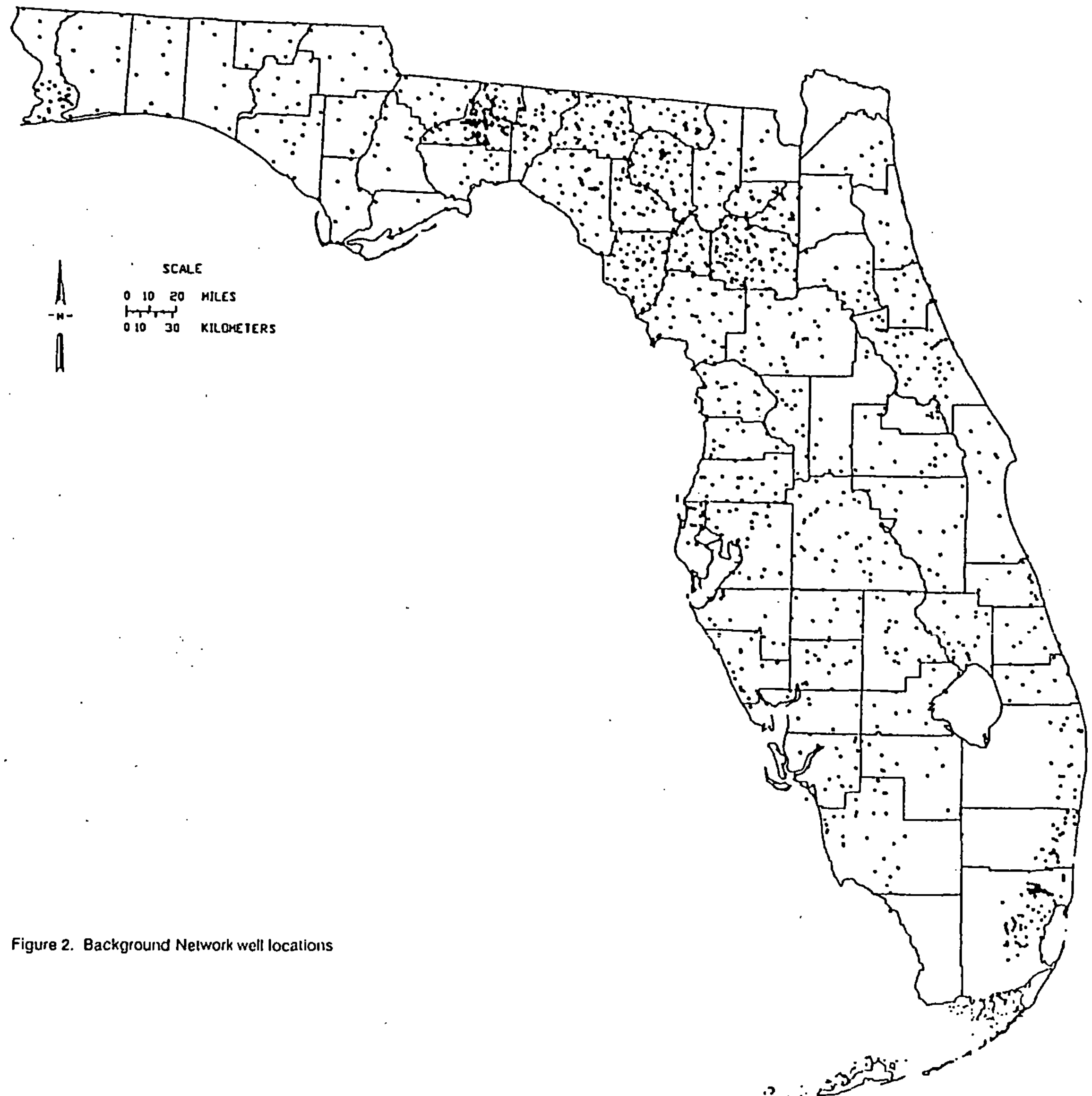


Figure 2. Background Network well locations

| SYSTEM | SERIES | PANHANDLE FLORIDA: LITHOSTRATIGRAPHIC UNIT | PANHANDLE FLORIDA: HYDROSTRATIGRAPHIC UNIT | NORTH FLORIDA: LITHOSTRATIGRAPHIC UNIT | NORTH FLORIDA: HYDROSTRATIGRAPHIC UNIT | SOUTH FLORIDA: LITHOSTRATIGRAPHIC UNIT | SOUTH FLORIDA: HYDROSTRATIGRAPHIC UNIT |
|---|---|---|---|---|---|---|---|
| QUARTERNARY | HOLOCENE / PLEISTOCENE | UNDIFFERENTIATED PLEISTOCENE-HOLOCENE SEDIMENTS | SURFICIAL AQUIFER SYSTEM | UNDIFFERENTIATED PLEISTOCENE-HOLOCENE SEDIMENTS<br>MICCOSUKEE FORMATION | SURFICIAL AQUIFER SYSTEM | UNDIFFERENTIATED PLEISTOCENE-HOLOCENE SEDIMENTS<br>MIAMI LIMESTONE<br>KEY LARGO LIMESTONE<br>ANASTASIA FORMATION<br>FORT THOMPSON FORMATION<br>CALOOSAHATCHEE FORMATION | SURFICIAL AQUIFER SYSTEM |
| TERTIARY | PLIOCENE | CITRONELLE FORMATION<br>MICCOSUKEE FORMATION<br>COARSE CLASTICS | | CYPRESSHEAD FORMATION<br>NASHUA FORMATION | | TAMIAMI FORMATION | |
| | MIOCENE | ALUM BLUFF GROUP<br>PENSACOLA CLAY<br>INTRACOASTAL FORMATION<br>HAWTHORN GROUP<br>BRUCE CREEK LIMESTONE<br>ST.MARKS FORMATION<br>CHATTAHOOCHEE FORMATION | INTERMEDIATE CONFINING UNIT | HAWTHORN GROUP<br>STATENVILLE FORMATION<br>COOSAWHATCHIE FM.<br>MARKSHEAD FORMATION<br>PENNY FARMS FORMATION<br>ST MARKS FORMATION | INTERMEDIATE AQUIFER SYSTEM OR CONFINING UNIT | HAWTHORN GROUP<br>PEACE RIVER FORMATION<br>BONE VALLEY MEMBER<br>ARCADIA FORMATION<br>TAMPA- NOCATEE MEMBERS | INTERMEDIATE AQUIFER SYSTEM OR CONFINING UNIT |
| | OLIGOCENE | CHICKASAWHAY LIMESTONE<br>SUWANNEE LIMESTONE<br>MARIANNA LIMESTONE<br>BUCATUNNA CLAY | FLORIDAN AQUIFER SYSTEM | SUWANNEE LIMESTONE | FLORIDAN AQUIFER SYSTEM | SUWANNEE LIMESTONE | FLORIDAN AQUIFER SYSTEM |
| | EOCENE | OCALA LIMESTONE<br>CLAIBORNE GROUP<br>UNDIFFERENTIATED SEDIMENTS | SUB-FLORIDAN CONFINING UNIT | OCALA LIMESTONE<br>AVON PARK FORMATION<br>OLDSMAR FORMATION | | OCALA LIMESTONE<br>AVON PARK FORMATION<br>OLDSMAR FORMATION | |
| | PALEOCENE | UNDIFFERENTIATED PALEOCENE ROCKS | | CEDAR KEYS FORMATION | SUB-FLORIDAN CONFINING UNIT | CEDAR KEYS FORMATION | SUB-FLORIDAN CONFINING UNIT |
| CRETACEOUS AND OLDER | | UNDIFFERENTIATED | | UNDIFFERENTIATED | | UNDIFFERENTIATED | |

Figure 4. Hydrostratigraphic Nomenclature (modified from Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986)

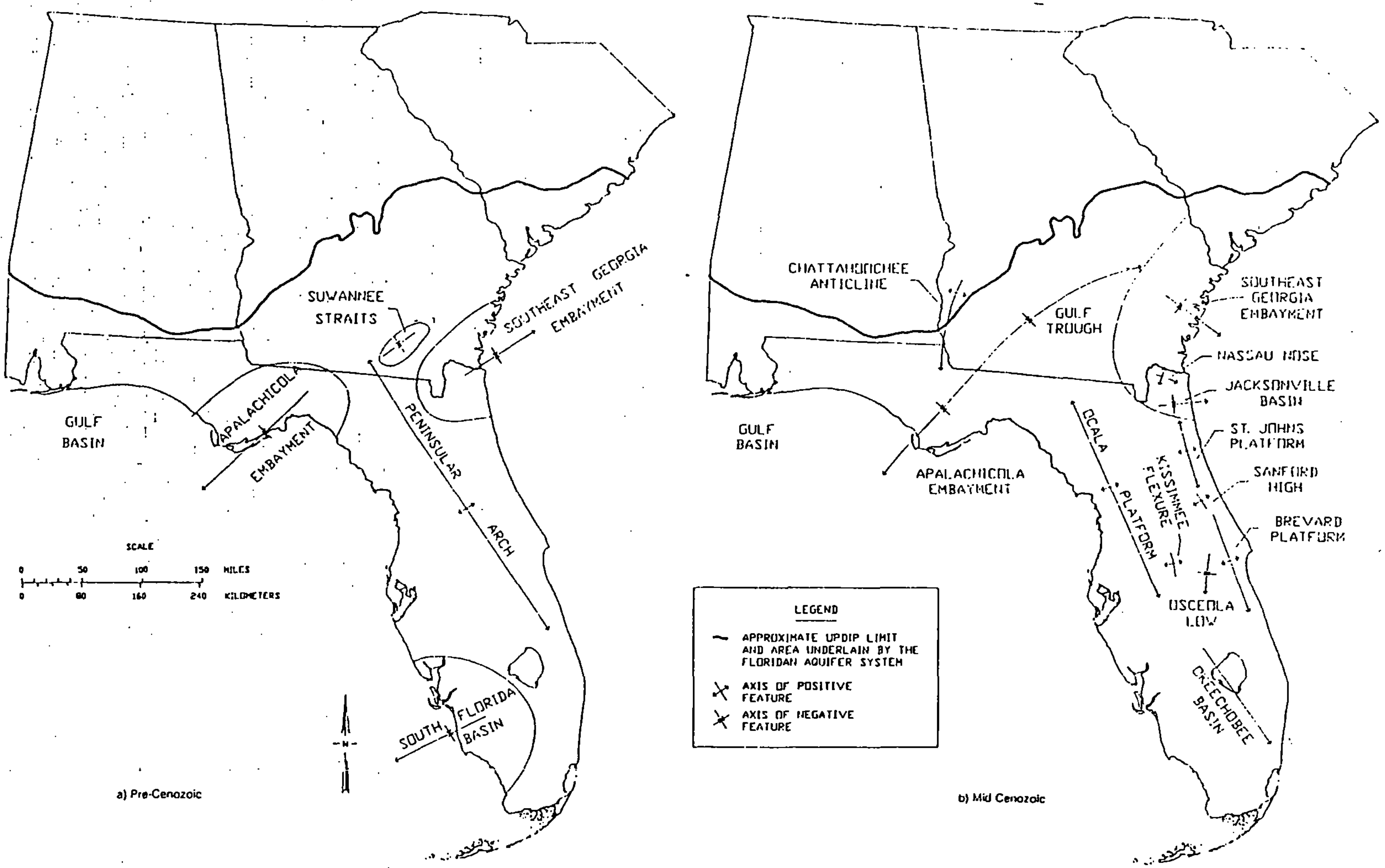


Figure 5. Structural Features of Florida
a) Pre-Cenozoic
b) Mid-Cenozoic

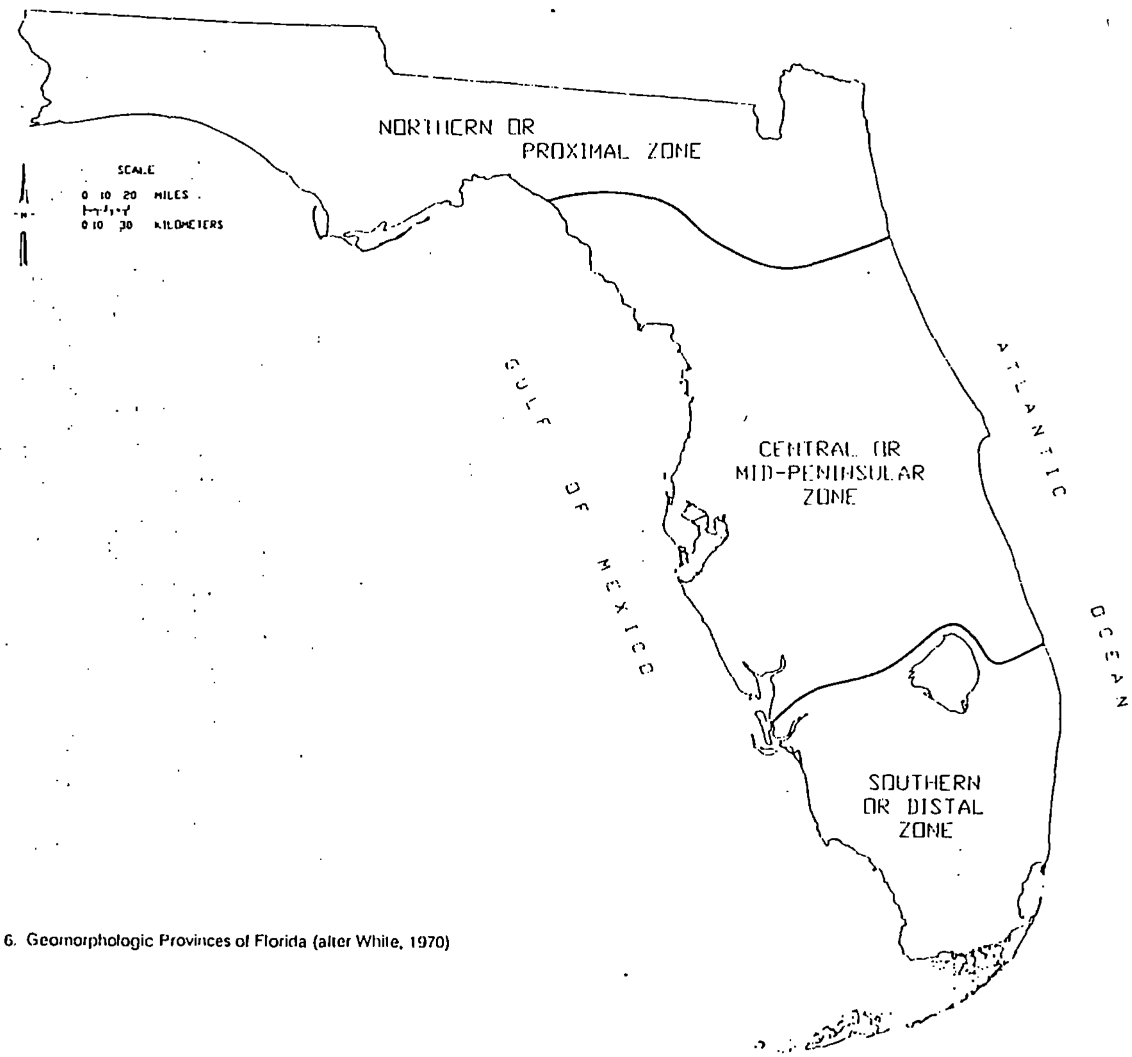


Figure 6. Geomorphologic Provinces of Florida (after White, 1970)

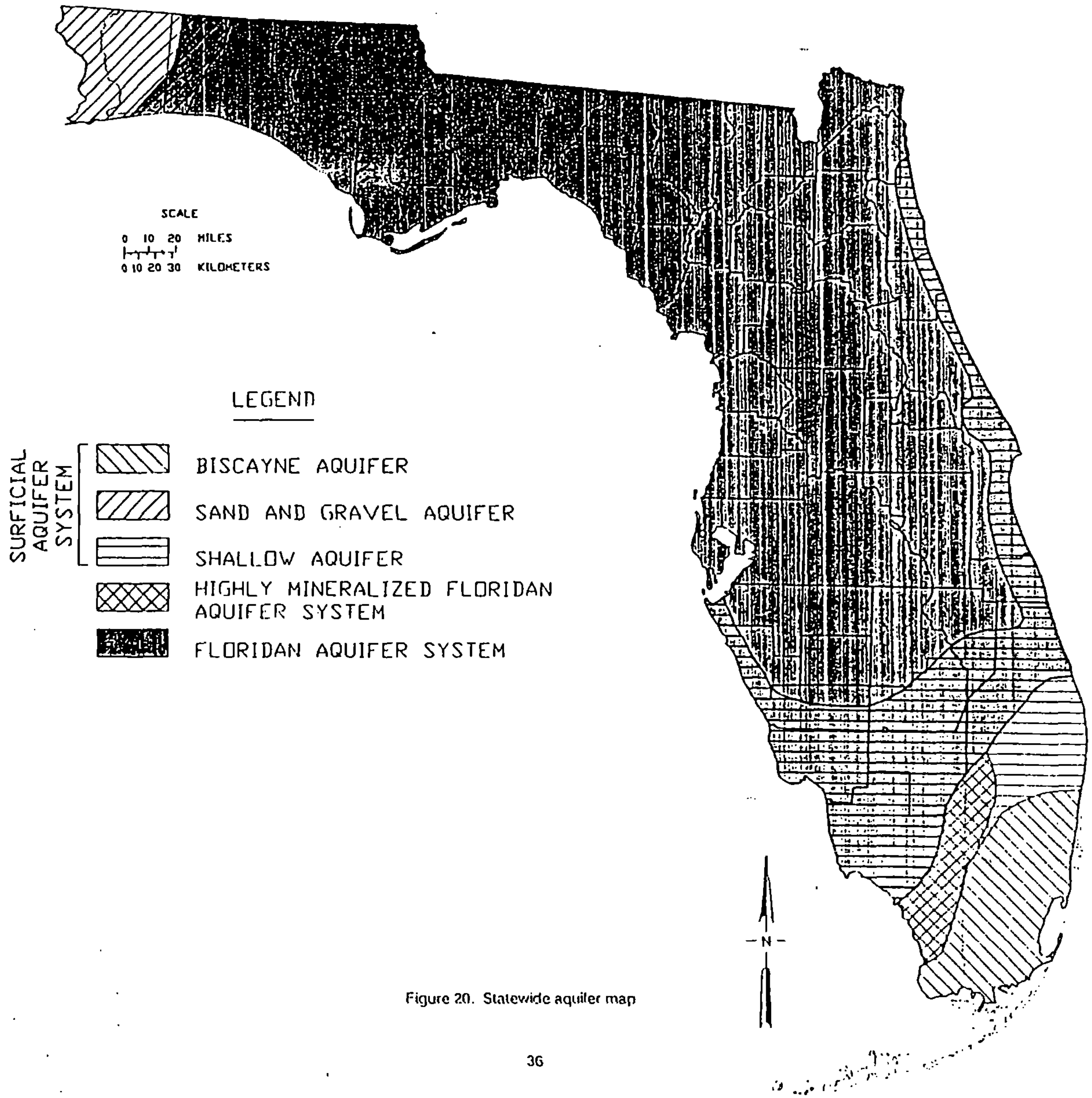


Figure 20. Statewide aquifer map

**CONVERSATION RECORD**

**To : Craig Feeny** **File Name : Pier Property Drum**

**From : Michael Corrigan**

**Contact Person : Dorathy Rayfield**
**EPA**

**Date : 3 / 30 / 96**

**Time : 12 :40 P.M.** **Phone No. :**

**Subject : information regarding buried drums at the Pier Property Drum Site**

---

Dorathy Rayfield told me that the Emergency Response Section @ Environmental Protection Agency has successfully removed all drums from this site back in early March 1996. All Drums were reported as being intact and not leaking. Monitoring wells were implemented. Ground water was found to be not impacted.

The site is located approximated 3 miles past I75 off SR 64 on the South side of SR 64. Site is comprised of approximately 10 acres

GROUND-WATER RESOURCE AVAILABILITY INVENTORY:
MANATEE COUNTY, FLORIDA

PREPARED BY: RESOURCE MANAGEMENT AND PLANNING DEPARTMENTS OF THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

MARCH 1988

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SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT



PRINCIPAL CONTRIBUTORS

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JOHN D. WATSON, Hydrologist, Resource Evaluation Section
ANTHONY E. GILBOY, Hydrologist, Resource Evaluation Section
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MARK D. BARCELO, Engineer, Resource Evaluation Section
STEVE C. CAMP, Hydrologist, Resource Evaluation Section
ROBERT CHRISTIANSON, Manager, Planning Department
REBECCA CLAYTON, Planner, Planning Department

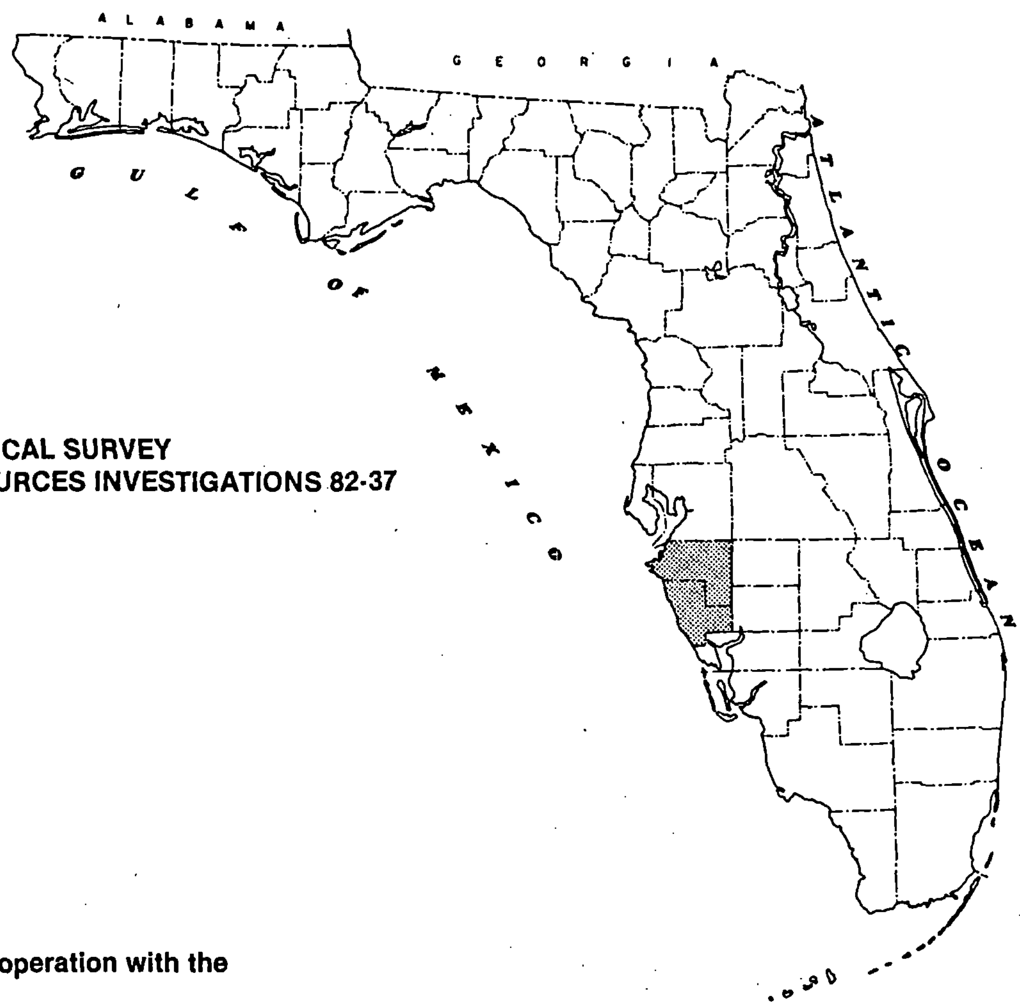
---

* Principal Author Manatee County Section Report.

Ref # 14-

# WATER RESOURCES AND DATA-NETWORK ASSESSMENT OF THE MANASOTA BASIN, MANATEE AND SARASOTA COUNTIES, FLORIDA






U.S. GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS 82-37

Prepared in cooperation with the

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

82-37 WATER RESOURCES AND DATA-NETWORK ASSESSMENT OF THE MANASOTA BASIN, MANATEE AND SARASOTA COUNTIES, FLORIDA 82-37

**STATE OF FLORIDA**
**DEPARTMENT OF NATURAL RESOURCES**
Tom Gardner, *Executive Director*

**DIVISION OF RESOURCE MANAGEMENT**
Jeremy A. Craft, *Director*

**FLORIDA GEOLOGICAL SURVEY**
Walter Schmidt, *State Geologist*

BULLETIN NO. 59

# THE LITHOSTRATIGRAPHY OF THE HAWTHORN GROUP (MIOCENE) OF FLORIDA

By
Thomas M. Scott

Published for the
**FLORIDA GEOLOGICAL SURVEY**
TALLAHASSEE
1988

PWS014 272847 822514 02 _ DRINKING WATER PROGRAM 03/29/96
LATITUDE/LONGITUDE RANGE LOOK UP 13:08:49

TYPE DISPLAYED: PLANT, SOURCE AND WELL

| LATITUDE | LONGITUDE | PWS-ID | PLT | SRC | WELL | MAILING NAME | ST/TP/RB |
|---|---|---|---|---|---|---|---|
| 27:27:10 | 82:27:05 | 6412503 | 01 | | | HARLLEE-LANE (41-22MLC) | A N D |
| 27:27:10 | 82:27:05 | 6412503 | 01 | 001 | | HARLLEE-LANE (41-22MLC) | A N D |

PWS014 272847 822514 03 _ DRINKING WATER PROGRAM 03/29/96
LATITUDE/LONGITUDE RANGE LOOK UP 13:10:17

TYPE DISPLAYED: PLANT, SOURCE AND WELL

| LATITUDE | LONGITUDE | PWS-ID | PLT | SRC | WELL | MAILING NAME | ST/TP/RB |
|---|---|---|---|---|---|---|---|
| 27:27:00 | 82:27:00 | 6412422 | 01 | 001 | | VALLEY FARMS MLC | A P D |
| 27:27:10 | 82:27:05 | 6412503 | 01 | | | HARLLEE-LANE (41-22MLC) | A N D |
| 27:27:10 | 82:27:05 | 6412503 | 01 | 001 | | HARLLEE-LANE (41-22MLC) | A N D |
| 27:28:00 | 82:23:00 | 6412426 | 01 | 001 | | FARMER'S INN; QUALITY MEATS | A N D |
| 27:28:31 | 82:22:27 | 6412426 | 01 | 001 | 0001 | FARMER'S INN; QUALITY MEATS | A N D |
| 27:28:31 | 82:22:27 | 6412426 | 01 | 001 | 0001 | FARMER'S INN; QUALITY MEATS | A N D |
| 27:28:31 | 82:22:27 | 6412426 | 01 | | | FARMER'S INN; QUALITY MEATS | A N D |
| 27:28:31 | 82:22:27 | 6412426 | 60 | | | FARMER'S INN; QUALITY MEATS | A N D |
| 27:29:19 | 82:27:47 | 6412422 | 01 | 001 | 0001 | VALLEY FARMS MLC | A P D |
| 27:29:19 | 82:27:47 | 6412422 | 01 | 001 | 0001 | VALLEY FARMS MLC | A P D |
| 27:29:19 | 82:27:47 | 6412422 | 01 | | | VALLEY FARMS MLC | A P D |
| 27:31:08 | 82:24:09 | 6410295 | 01 | 001 | | CHRISTIAN RETREAT CAMPGROUND | A C D |
| 27:31:11 | 82:25:07 | 6412473 | 01 | 001 | | AQUA-TEL RESORT | A O H |
| 27:31:11 | 82:25:07 | 6412473 | 01 | | | AQUA-TEL RESORT | A O H |
| 27:31:11 | 82:25:07 | 6412478 | 01 | 001 | | CAMP FLYING EAGLE | A N D |
| 27:31:11 | 82:25:07 | 6412478 | 01 | | | CAMP FLYING EAGLE | A N D |

PWS001 6412503 DRINKING WATER PROGRAM 03/29/96
SYSTEM INVENTORY INFORMATION PART 1 13:14:15
LAST UPDATED: 03/07/95

STATUS: A = ACTIVE RE-ACTIVATION DT: 11/ 01/ 91
BEGIN DT: 11/ 91 INACT DT: __/__/__ INACT REASON: _ = ........................
PWS TYPE: N = NONCOMMUNITY CATG./CLASS: 5D REG BY: D (D=DER OR H=HRS)
NC SEASON BEG: 10/ 01 END: 05/ 30 NUCLEAR FACIL: _ (REACTOR, WASTE OR OTHER)

SYSTEM NAME: HARLLEE-LANE_(41-22MLC)_______ GENERAL MAIL: Y (Y OR N)
ADDRESS: SR_64&_I-75_ON_HARLLEE_RD_____ PHONE: ( 813 ) 722 - 7747
CITY: PALMETTO___________ STATE: FL ZIP CODE: 34220 - ____

OWNER NAME: HARLLEE_FARMS_INC____________ GENERAL MAIL: Y (Y OR N)
ADDRESS: P.O._BOX_8_________________ PHONE: ( 813 ) 722 - 7747
CITY: BRADENTON__________ STATE: FL ZIP CODE: 34220 - ____
OWNER TYPE: I = INVESTOR
INSPECTOR'S INITIALS: WLP
DATE OF VISIT: 03/ 07/ 95 CLASS: SS PRIOR VISIT: 09/ 23/ 92 PRIOR CLASS: 01
PERSON CONTACTED: JIM_EDMONDS_________________ TITLE: OPERATOR___________
CONTACT PHONE: ( 813 ) 955 - 7764 SANITARY SURVEY: 03/ 07/ 95

PWS002 6412503 DRINKING WATER PROGRAM 03/29/96
SYSTEM INVENTORY INFORMATION PART 2 13:15:04
LAST UPDATED: 03/07/95
MAILING NAME: HARLLEE-LANE (41-22MLC) ACTIVE NONCOMMUNITY
BACT NON COMPLIER: _
RET POP SERVED: _______26 BACT SAMPLES REQ'D: __2 RULE MIN: 2
DESIGN CAP: ________2,000 (GPD) RADS SAMPLES REQ'D: ___
MAXIMUM DAY: ________2,000 (GPD) RADS SAMPLES FREQY: ____ (MONTHS)
% DESIGN CAP: 100.0 TTHM SAMPLES REQ'D: ___
AVG PRODUCTION: 2,000 (GPD) TTHM SAMPLES FREQY: _____ (MONTHS)
MAXIMUM/HOUR: ____________ (G) SERVICE CONNECTIONS: _______4
TOT STORAGE CAP: _________220 (G) NUMBER METERED: _________
METER CAP: __________________ TYPE OF METER: __________________
(*LEAD AND COPPER*) CONSEC INDIC: 0 = NOT CONSECUTIVE
(*DEFAULT COMP PERIOD 01/93 06/93 POP GRP:G *)
(*M/R STATUS:I SAMPLES REQ'D:__5 RULE MIN: 5 CONSOLIDATED: N Y/N *)
1SERVAREA: LC = LABOR CAMP TOTAL # OF PLANTS: 1
2SERVAREA: AP = APARTMENT TOTAL # OF SOURCES: 1

PRIMARY PLANT: 1 LATITUDE: 27:27:10 LONGITUDE: 82:27:05
PRIMARY SOURCE: 1 LATITUDE: 27:27:10 LONGITUDE: 82:27:05
CREDIT (Y/N) VOC: N PEST: N DIOXIN WAIVER: Y (Y/N)

PWS004 6412503 01 001 DRINKING WATER PROGRAM 03/29/96
SOURCE INFORMATION 13:15:26
LAST UPDATED: 10/31/91

MAILING NAME: HARLLEE-LANE (41-22MLC) ACTIVE NONCOMMUNITY
PLANT NAME: HARLEE FARMS WELL #1 ACTIVE PLANT NUMBER: 1
SOURCE NAME: HARLLEE_LANE_WELL_1__________
SOURCE NUMBR: 001 SOURCE STATUS: A = ACTIVE **** LAT LONG *****************
LATITUDE: 27:27:10.000 LONGITUDE: 82: 27:05.000 * COLLECTION DATE: __/__/__ *
* COLLECTION METHOD: U UNKNOWN*
SOURCE AVAILABILITY: P = PERMANENT
SOURCE AVG PRODUCTION: ________2,000 (GPD) % OF SYSTEM PRODUCTION: 100

ANN % SOURCE TYPE: G = GROUND
100 GROUND, NUMBER OF WELLS: __1

DATE 11/05/90 21:37:05 SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT PAGE 4746

WELL CONSTRUCTION PERMITTING

R000055 PERMIT SUMMARY FROM: 00/00/00 TO 99/99/99

CY: COUNTY: BASIN: S: - T: R: DEPTH: 0 TO 9999 DIAMETER: 0 TO 99 METHOD: USE: CASE DEPTH:

| PERMIT | STATUS | DRILL LICN NUMBR | USE | BASIN | COUNTY | LOCATION QQQ S T R | DIA | CASE DEPH | WELL DEPH | GROUT | BG RS | METHOD | SWL TAE ATV TEE IRL C | SPCAP | CHLOR | IRON | SULF | USER-ID | LOT | LITH | OWNER NAME |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 470050 | I | 2889 | Y | 21 | 081 | C 0 063519 | 2 | | | | | | | | | | | | | | FISHER, STEVE |
| 448332 | I | 1627 | A | 21 | 081 | 0 0 063519 | 5 | 127 | 460 | Y | 37 | R | 9 | | | | | | 0000 | NO | WAHL (DESIGN HOMES) |
| 448045 | I | 1627 | L | 21 | 081 | 0 0 103519 | 5 | 61 | 220 | Y | 18 | R | 28 | | | | | | 0000 | NO | SCHMITT, ED |
| 464186 | I | 2383 | A | 21 | 081 | 0 0 113519 | 4 | 45 | 125 | | 0 | C | 10 | | | | | | 0000 | NO | CROFT, HAROLD |
| 333583 | C | 1662 | D | 15 | 017 | 0 0 133519 | 4 | 76 | 100 | | 0 | J | 0 | | | | | 000000 | | NO | SWEENEY R I |
| 333584 | C | 1662 | D | 15 | 017 | 0 0 133519 | 4 | 84 | 100 | | 0 | J | 0 | | | | | 000000 | | NO | SWEENEY R I |
| 447373 | N | 1051 | A | 21 | 081 | 0 0 143519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | FREELAND |
| 700303 | C | 1051 | A | 21 | 081 | 0 0 153519 | 3 | | | | | | | | | | | | | | HAGGERTY, J. W. |
| 446095 | I | 1360 | A | 21 | 081 | 0 0 153519 | 4 | 98 | 130 | | 0 | C | 20 | | | | | | 0000 | NO | SCHWARTZ PETER |
| 700504 | C | 1051 | D | 21 | 081 | 0 0 153519 | 3 | | | | | | | | | | | | | | TUTTLE, L. R. |
| 300619 | C | 1013 | D | 21 | 081 | 0 0 153519 | 4 | 32 | 200 | N | 0 | C | 15 | | | | | 77-439 | | NO | WEST, HUGH |
| 301419 | C | 1360 | D | 21 | 081 | 0 0 153519 | 4 | 84 | 150 | | 0 | C | 21 | A | | | | 000000 | | NO | HOWARD, B |
| 301621 | C | 1360 | D | 21 | 081 | 0 0 153519 | 4 | 84 | 150 | N | 0 | C | 22 | A | | | | 78-325 | | NO | CURTISS, LAWRENCE |
| 302854 | C | 1013 | D | 21 | 081 | 0 0 153519 | 4 | 77 | 175 | N | 0 | R | 18 | | | | | M79-28 | | NO | SCHILLINGS, OTIS |
| 700045 | C | 1360 | D | 21 | 081 | 0 0 153519 | 9 | | | | | | | | | | | | | | HOWARD, BARRY |
| 700509 | C | 1013 | D | 21 | 081 | 0 0 153519 | 4 | | | | | | | | | | | | | | FRUCHEY, DAN |
| 446876 | N | 1376 | D | 21 | 081 | 0 0 153519 | 5 | *** CANCELLED *** | | | | | | | | | | | | | SHERMAN, LEE |
| 449243 | N | 1013 | A | 21 | 081 | 0 0 163519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | DAVIS, GEORGE |
| 447406 | I | 1627 | A | 21 | 081 | 0 0 163519 | 5 | 80 | 540 | Y | 22 | R | 12 | | | | | | 0000 | NO | HORVATH, JEFF |
| 464249 | I | 1627 | D | 21 | 081 | 0 0 163519 | 5 | 107 | 300 | Y | 29 | R | 35 | | | | | | 0000 | NO | BAUM, ROB |
| 470307 | I | 2874 | A | 21 | 081 | 0 0 173519 | 4 | | | | | | | | | | | | | | CONOVER, JENEAN |
| 450983 | I | 1013 | D | 21 | 115 | C 0 173519 | 4 | 68 | 210 | | 0 | R | 5 | | | | | | 0000 | NO | BARTANO |
| 447386 | N | 1376 | A | 21 | 081 | 0 0 183519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | CABAILERO, JESSE |
| 447500 | N | 2224 | A | 21 | 081 | 0 C 183519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | THE ATRIUMS |
| 448258 | I | 1030 | A | 21 | 081 | 0 C 183519 | 4 | 73 | 180 | | 0 | C | 19 | | | | | | 0000 | NO | DOUGLAS, GERALD |
| 700791 | C | 1013 | A | 21 | 081 | 0 0 183519 | 4 | | | | | | | | | | | | | | KINTZ, KEENAN |
| 700640 | C | 1627 | D | 21 | 081 | 0 0 183519 | 4 | | | | | | | | | | | | | | PURSLEY INC. |
| 445763 | I | 1360 | A | 21 | 081 | 0 0 193519 | 4 | 106 | 284 | | 0 | C | 15 | | | | | | 0000 | NO | BALSINGER PEARL |
| 447427 | I | 1360 | A | 21 | 081 | C 0 193519 | 4 | 48 | 160 | | 0 | C | 25 | | | | | | 0000 | NO | SIKES, ERNEST |
| 443241 | I | 1360 | A | 21 | 081 | 0 0 193519 | 4 | 47 | 160 | | C | C | 22 | | | | | | 0000 | NO | FRAZIER, E.S. SR. |
| 448849 | I | 1360 | A | 21 | 081 | 0 0 193519 | 4 | 0 | 155 | | 0 | C | 22 | | | | | | 0000 | NO | HUDSON, GLENN |
| 449633 | I | 2874 | A | 21 | 081 | 0 0 193519 | 4 | 50 | 120 | | 0 | C | 12 | | | | | | 0000 | NO | RUTENBERY HOMES |
| 471267 | I | 1360 | A | 21 | 081 | 0 0 193519 | 4 | | | | | | | | | | | | | | PHILLIPS, GEORGE |
| 449249 | I | 1627 | A | 21 | 081 | 0 0 193519 | 5 | 102 | 460 | Y | 28 | R | 21 | | | | | | 0000 | NO | MANATEE CO. SCHOOL BOARD |
| 464321 | I | 2874 | Y | 21 | 081 | 0 0 193519 | 6 | | | | | | | | | | | | | | PURSLEY |
| 464322 | I | 2874 | Y | 21 | 081 | 0 C 193519 | 8 | | | | | | | | | | | | | | PURSLEY & ASSOC. |
| 464323 | I | 2874 | Y | 21 | 081 | 0 0 193519 | 8 | | | | | | | | | | | | | | PURSLEY & ASSOC. |
| 300134 | C | 1627 | D | 21 | 081 | 0 0 223519 | 4 | 109 | 183 | N | 0 | T | 24 | A | K | D | | 76-324 | | NO | CHAPMAN CONTRACTING CO |
| 461096 | I | 2367 | D | 21 | 115 | 0 0 233519 | 2 | 13 | 13 | | 0 | R | 4 | | | | | | 0000 | NO | AMOCO |

DATE 11/05/90 21:37:05 SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT PAGE 4746

WELL CONSTRUCTION PERMITTING

RSB0055 PERMIT SUMMARY FROM: 00/00/00 TO 99/99/99

BY: COUNTY: BASIN: S: - T: R: DEPTH: 0 TO 9999 DIAMETER: 0 TO 99 METHOD: USE: CASE DEPTH:

| PERMIT | STATUS | DRILL LICN NUMBR | USE | BASIN | COUNTY | LOCATION QQQ | S T R | DIA | CASE DEPH | WELL DEPH | GROUT | NBR BAGS | METHOD | STATIC WATER LEVEL | SPCAP | CHLOR | IRON | SULF | USER-ID | LOT | LITH | OWNER NAME |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 470050 | I | 2884 | Y | 21 | 081 | 0 0 | 063519 | 2 | | | | | | | | | | | | | | FISHER, STEVE |
| 448332 | I | 1627 | A | 21 | 081 | 0 0 | 063519 | 5 | 127 | 460 | Y | 37 | R | 9 | | | | | | 0000 | NO | WAHL (DESIGN HOMES) |
| 448095 | I | 1627 | L | 21 | 081 | 0 0 | 103519 | 5 | 61 | 220 | Y | 18 | R | 28 | | | | | | 0000 | NO | SCHMITT, ED |
| 464186 | I | 2383 | A | 21 | 081 | 0 0 | 113519 | 4 | 45 | 125 | | 0 | C | 10 | | | | | | 0000 | NO | CROFT, HAROLD |
| 333583 | C | 1662 | D | 15 | 017 | 0 0 | 133519 | 4 | 76 | 100 | | 0 | J | 0 | | | | | 000000 | | NO | SWEENEY R I |
| 333584 | C | 1662 | D | 15 | 017 | 0 0 | 133519 | 4 | 34 | 100 | | 0 | J | 0 | | | | | 000000 | | NO | SWEENEY R I |
| 447373 | N | 1051 | A | 21 | 081 | 0 0 | 143519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | FREELAND |
| 700303 | C | 1051 | A | 21 | 081 | 0 0 | 153519 | 3 | | | | | | | | | | | | | | HAGGERTY, J. W. |
| 446045 | I | 1360 | A | 21 | 081 | 0 0 | 153519 | 4 | 48 | 130 | | 0 | C | 20 | | | | | | 0000 | NO | SCHWARTZ PETER |
| 700504 | C | 1051 | D | 21 | 081 | 0 0 | 153519 | 3 | | | | | | | | | | | | | | TUTTLE, L. R. |
| 300619 | C | 1013 | D | 21 | 081 | 0 0 | 153519 | 4 | 32 | 200 | N | 0 | C | 15 | | | | | 77-439 | | NO | WEST, HUGH |
| 301419 | C | 1360 | D | 21 | 081 | 0 0 | 153519 | 4 | 54 | 152 | | 0 | C | 21 | A | | | | 000000 | | NO | HOWARD,B |
| 301621 | C | 1360 | D | 21 | 081 | 0 0 | 153519 | 4 | 84 | 150 | N | 0 | C | 22 | A | | | | 78-325 | | NO | CURTISS, LAWRENCE |
| 302854 | C | 1013 | D | 21 | 081 | 0 0 | 153519 | 4 | 77 | 175 | N | 0 | R | 18 | | | | | M79-28 | | NO | SCHILLINGS, OTIS |
| 700045 | C | 1360 | D | 21 | 081 | 0 0 | 153519 | 4 | | | | | | | | | | | | | | HOWARD, BARRY |
| 700509 | C | 1013 | D | 21 | 081 | 0 0 | 153519 | 4 | | | | | | | | | | | | | | FRUCHEY, DAN |
| 446876 | N | 1376 | D | 21 | 081 | 0 0 | 153519 | 5 | *** CANCELLED *** | | | | | | | | | | | | | SHERMAN, LEE |
| 449243 | N | 1013 | A | 21 | 081 | 0 0 | 163519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | DAVIS, GEORGE |
| 447436 | I | 1627 | A | 21 | 081 | 0 0 | 163519 | 5 | 80 | 540 | Y | 22 | F | 12 | | | | | | 0000 | NO | HORVATH, JEFF |
| 464249 | I | 1627 | D | 21 | 081 | 0 0 | 163519 | 5 | 107 | 300 | Y | 29 | R | 35 | | | | | | 0000 | NO | BAUM, ROB |
| 470327 | I | 2874 | A | 21 | 081 | 0 0 | 173519 | 4 | | | | | | | | | | | | | | CONOVER, JENEAN |
| 450983 | I | 1013 | D | 21 | 115 | 0 0 | 173519 | 4 | 68 | 210 | | 0 | R | 5 | | | | | | 0000 | NO | BARTANO |
| 447096 | N | 1376 | A | 21 | 081 | 0 0 | 183519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | CABALLERO, JESSE |
| 447590 | N | 2224 | A | 21 | 081 | 0 0 | 183519 | 4 | *** CANCELLED *** | | | | | | | | | | | | | THE AIRHUMS |
| 448238 | I | 1030 | A | 21 | 081 | 0 0 | 183519 | 4 | 73 | 180 | | 0 | C | 19 | | | | | | 0000 | NO | DOUGLAS, GERALD |
| 700791 | C | 1013 | A | 21 | 081 | 0 0 | 183519 | 4 | | | | | | | | | | | | | | KINTZ, KEENAN |
| 700640 | C | 1627 | D | 21 | 081 | 0 0 | 183519 | 4 | | | | | | | | | | | | | | PURSLEY INC. |
| 445763 | I | 1360 | A | 21 | 081 | 0 0 | 193519 | 4 | 106 | 284 | | 0 | C | 15 | | | | | | 0000 | NO | BALSINGER PEARL |
| 447427 | I | 1360 | A | 21 | 081 | 0 0 | 193519 | 4 | 48 | 160 | | 0 | C | 25 | | | | | | 0000 | NO | SIKES, ERNEST |
| 448241 | I | 1360 | A | 21 | 081 | 0 0 | 193519 | 4 | 47 | 163 | | C | C | 22 | | | | | | 0000 | NO | FRAZIER, E.S. SR. |
| 448849 | I | 1360 | A | 21 | 081 | 0 0 | 193519 | 4 | 0 | 155 | | 0 | C | 22 | | | | | | 0000 | NO | HUDSON, GLENN |
| 449633 | I | 2874 | A | 21 | 081 | 0 0 | 193519 | 4 | 50 | 120 | | 0 | C | 12 | | | | | | 0000 | NO | RUTENBERY HOMES |
| 471267 | I | 1360 | A | 21 | 081 | 0 0 | 193519 | 4 | | | | | | | | | | | | | | PHILLIPS, GEORGE |
| 449249 | I | 1627 | A | 21 | 081 | 0 0 | 193519 | 5 | 102 | 460 | Y | 23 | R | 21 | | | | | | 0000 | NO | MANATEE CO. SCHOOL BOARD |
| 464321 | I | 2874 | Y | 21 | 081 | 0 0 | 193519 | 6 | | | | | | | | | | | | | | PURSLEY |
| 464322 | I | 2874 | Y | 21 | 081 | 0 0 | 193519 | 6 | | | | | | | | | | | | | | PURSLEY & ASSOC. |
| 464323 | I | 2874 | Y | 21 | 081 | 0 0 | 193519 | 3 | | | | | | | | | | | | | | PURSLEY & ASSOC. |
| 300134 | C | 1627 | D | 21 | 081 | 0 0 | 223519 | 4 | 109 | 183 | N | 0 | T | 24 | A | K | D | | 76-324 | | NO | CHAPMAN CONTRACTING CO |
| 461096 | I | 2867 | O | 21 | 115 | 0 0 | 233519 | 2 | 13 | 13 | | 0 | R | 4 | | | | | | 0000 | NO | AMOCO |

U.S. EPA REGION IV

# SDMS

## Unscannable Material Target Sheet

DocID: 10692457　　Site ID: FL0001096718

Site Name: Pier Property Drum

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Nature of Material:

| | | | |
|---|---|---|---|
| Map: | ☒ | Computer Disks: | ☐ |
| Photos: | ☐ | CD-ROM: | ☐ |
| Blueprints: | ☐ | Oversized Report: | ☐ |
| Slides: | ☐ | Log Book: | ☐ |

Other (describe): Flood Insurance Rate Map (Ref. 18)

Amount of material: ______

* Please contact the appropriate Records Center to view the material *